

Silica baseline survey

Main report

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Aims and Objectives

This Silica Baseline Survey aims to develop baseline intelligence on exposure and control of respirable crystalline silica in key industry sectors. These sectors are:

- Brickworks and Tile Manufacture
- Stonemasonry
- Quarrying
- Construction

The objectives are:

- 1) to establish whether exposure control practices (both the application of engineering controls and the use of RPE) are adequate to reduce exposures below the WEL for RCS
- 2) to form an opinion about the long-term reliability of the controls
- 3) to identify common causes of failures of exposure control
- 4) to provide data by which the effect of HSE interventions can be assessed.

This annexe to the main SBS report includes the site visit data and detailed discussion of observations in the brickmaking sector.

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CONTENTS

1	AIMS AND OBJECTIVES	1
2	INTRODUCTION	2
2.1	HSE Silica Baseline Survey.....	2
2.2	Information Sources.....	3
2.3	Health Effects of Exposure to RCS.....	3
2.4	Respiratory Disease – Epidemiological data	4
2.5	Exposure Limits	5
2.6	Technical background: Silica and rock types.....	5
2.7	Exposure Mechanisms	7
3	SITE ASSESSMENT METHODOLOGY	9
3.1	Site selection	9
3.2	Competency descriptors for exposure Control and RPE	12
3.3	Exposure Measurements.....	14
3.4	Follow-up questionnaire.....	14
4	RESULTS	15
4.1	General comments	15
4.2	Brickmaking	15
4.3	Construction	16
4.4	Stonemasonry	17
4.5	Quarry industry	19
5	DISCUSSION	21
5.1	Brickmaking.....	21
5.2	Construction	22
5.3	Stonemasonry	25
5.4	Quarry industry	27
5.5	SBS assessment process.....	28
6	CONCLUSIONS	29
7	APPENDICES	32
	Appendix A: Tables	32
	Appendix B Competency Survey Tables	41
	Appendix C: Standard Industrial Classification subdivisions	45
	Appendix D: Report of THOR Enquiry.....	52
	Appendix E - Stonemasonry Industry: Follow-up Questionnaire	56
8	REFERENCES	57

EXECUTIVE SUMMARY

Aims and Objectives

This Silica Baseline Survey (SBS) was commissioned to develop baseline intelligence on exposure and the control of respirable crystalline silica (RCS) in key industry sectors. These sectors are:

Brickworks and Tile Manufacture
Stonemasonry
Quarrying
Construction

The objectives were:

- 1) to establish whether exposure control practices (both the application of engineering controls and the use of respiratory protective equipment (RPE)) are adequate to reduce exposures below the Workplace Exposure Limit (WEL) for RCS
- 2) to form an opinion about the long-term reliability of the controls
- 3) to identify common causes of failures of exposure control
- 4) to provide data by which the effect of HSE interventions can be assessed.

This report draws together the main points from the reports of the work in the four sectors. It was not the intention to compare the performance of the sectors or to draw comparative conclusions, although some common themes emerged. Full details of the SBS work in each of the sectors are shown in the sector-specific annexes to this report.

Method

A total of 38 assessment visits were made across the four sectors and some data from recent HSE enforcement visits were also used. RCS and respirable dust exposures were monitored at each location and structured qualitative assessments were made of the effectiveness and robustness of the engineered exposure controls and of the RPE use. 209 new exposure measurements were made, plus 48 static (background) measurements.

Main Findings-common issues.

The results of measurements for the SBS made between 2005 and 2008 suggest that in all the four sectors examined actual RCS exposures may be higher than earlier HSE estimates and industry estimates made as a response to the questionnaire issued before the HSE Regulatory Impact Assessment was prepared.

In many locations there is still a need to bring assessments under the Control of Substances Hazardous to Health (“COSHH”) Regulations for tasks that cause RCS exposure to a standard commensurate with the risks from exposure.

In every sector where RPE needs to be used to control exposure more robust policies are needed to ensure that fit testing is performed and that staff training is adequate to ensure the necessary level of protection.

Many employers in the Brickmaking and Quarry sectors have invested significantly in exposure control measures. Some items of construction plant and machinery have also been modified to minimise exposure, but very little progress is evident in the stonemasonry sector.

Brick findings

Of 97 worker exposure measurements considered in the SBS, 29% exceeded 0.1 mg.m^{-3} 8hr as a time-weighted average (TWA.) This includes 5% which indicated RCS exposure above 0.3 mg.m^{-3} .

Automation has been applied to some processes (e.g. the introduction of tunnel kilns) but has been unable to eliminate some processes which generate dust, for example as bricks are moved, so risk of exposure remains for tasks such as machine supervision

Demand for bricks produced using traditional, dustier, methods remains. These production facilities continue to require high numbers of workers but the introduction of engineering controls at these facilities can be difficult. 71% of personal measurements at a site using Hoffman kilns indicated exposure above 0.1 mg.m^{-3} RCS, as opposed to an average of 23% across the other brickmaking sites, the worst of which showed 56% of measurements over 0.1 mg.m^{-3} .

Engineering control measures (e.g. local Exhaust ventilation (LEV)) are neither universally installed (where they could be expected to work) nor fully effective. Better-specified and engineered systems are necessary if the full benefits of such investment are to be realised.

Construction findings

Research indicates that many employers underestimate the extent of RCS exposures in construction. While only a small number of sites were visited in this study, it was found that in many cases exposure control has not been treated as a priority. All RCS measurements made for the SBS which exceeded the WEL were during work where either no attempt had been made to control exposure or where it could be anticipated that the attempt would fail. Conversely, no measurement exceeded the WEL at any site that had applied well-designed controls.

Assessment of “control competence,” i.e. the robustness of the systems underpinning the effectiveness of engineered exposure controls or Respiratory Protective Equipment shows a similar picture. Employers who have made assessments are likely to maintain effective ongoing exposure control (principally by adopting engineered control measures) but those who have not are unlikely to achieve control.

Implementation of engineered controls as standard would in most cases reduce exposures to within WELs. Conversely, where controls are not applied (e.g. dry grit-blasting buildings or cutting out mortar without effective dust suppression or on-tool extraction) exposures can greatly exceed WELs.

Where high-value plant has been introduced (e.g. rock-drilling machines in tunnelling or crushers at recycling plants) dust suppression measures are more likely to have been installed than where small items of plant are in use.

RPE competency is not adequate to ensure reliable protection when engineered controls are not applied.

Stonemasonry findings

Of 94 measurements of RCS exposure, nearly 20% exceeded the higher WEL that applied when the samples were taken (0.3 mg.m^{-3}), with a further 23% exceeding the more recent limit of 0.1 mg.m^{-3} . The picture was in fact worse than these figures show, as during at least two visits all or most of the stone being worked had a low silica content. (RCS exposure is highly dependant upon the type of stone worked, but exposure may even occur as a consequence of working limestone or marble.) 21% of measurements showed respirable dust exposure above 4 mg.m^{-3} .

Engineering controls were usually either completely lacking or of limited effectiveness, the latter due either to the selection of unsuitable equipment or inadequate design and installation.

Without well-organised controls based on thorough planning, unacceptable respirable dust exposures are likely, even if RCS exposure should happen to be low due to work with stone of low silica content.

Quarries- findings

Large modern items of mobile and static plant tend to have exposure control measures installed as standard, but ongoing effectiveness of these measures depends on effective maintenance.

Of 61 measurements of RCS made for the SBS work, only one indicated 8-hr TWA exposure above the WEL of 0.3 mg.m^{-3} that applied at the start of the study. A further 10 measurements indicated exposure above the 2006 WEL of 0.1 mg.m^{-3} . No measurements showed respirable dust exposure above 4 mg.m^{-3} and only one was above half this figure.

Small-scale employers exist who may not have arranged access to professional health and safety advice. Large quarry groupings are well-equipped in terms of health and safety expertise, but (lack of) actions by local management and supervision can undermine exposure control regimes (e.g. lack of attention to detail in maintenance of systems.) This might be addressed to some extent by the operation of the Social Dialogue Agreement.

Annual exposure monitoring is common among the larger employers but by no means universal. The same position applies with regard to health surveillance.

Recommendations - General

Where personal protective equipment has to be relied upon to control exposure it needs to be used much more effectively. This will require better selection, training, cleaning and maintenance of equipment.

Exposure monitoring and health surveillance programmes should continue in order to assess the effectiveness of exposure controls, to improve the data pool and to increase knowledge of exposure profiles.

Brick recommendations

Communication between HSE and the UK brickmaking industry is considered to have been relatively good historically. The remaining causes of RCS exposure may be effectively addressed if the working relationship can be maintained between HSE and stakeholders. The issue of communicating with and influencing smaller employers (who may not belong to trade associations) will remain in the brick and heavy clay sector, as it does elsewhere in industry.

Consideration should be given to the way in which Hoffman kilns could be adapted to ventilate the chambers by a directional airflow during removal of the fired bricks.

Research into substitution of non-silica based alternatives in surface dressing might offer a means of eliminating one source of exposure. RCS generation from the comminution of fired clay particles will remain an ever-present hazard, however, and any new facilities should incorporate robust well-designed engineering controls.

Stonemasonry recommendations

Vocational training should include better information on silica health risks, the causes of exposure and the use of controls and also better technical knowledge about stone composition. The availability and uses of Silica Essentials should also be highlighted during courses.

Tools designed to be compatible with dust-suppression should be developed or adopted, e.g. powered by compressed air or by electric motors useable in wet conditions. Introduction of water-based dust suppression systems will require parallel modifications to personal protective equipment (PPE) (i.e. to accommodate wet work) and drainage arrangements to cope with stone dust in workshop run-off.

In parallel with improved dust suppression greater expertise needs to be applied to the selection, performance and maintenance of other engineering control measures (e.g. LEV.) The suppliers of LEV also need to improve the standard of their offerings.

The expertise applied to the selection, training, cleaning and use of personal protective equipment requires upgrading in the same way as control expertise needs improving.

Initiatives are still required to improve industry knowledge of control measures and the revised WEL.

The Construction sector is so diverse that detailed recommendations are not made. The general recommendations made above apply, however.

Silica exposures were relatively well controlled at the **Quarry sites** visited. Improvements in COSHH assessments and the way they are used might help ensure that exposure controls are better maintained.

1 AIMS AND OBJECTIVES

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2 INTRODUCTION

HSE has established a Disease Reduction Programme (DRP) as part of the FIT3 strategic programme (i.e. fit for work, fit for life, fit for tomorrow.) The aim of the DRP is to reduce the incidence of work-related ill health caused by exposure to hazardous substances between 2005 and 2010. Respiratory disease, covering occupational asthma as well as the longer latency diseases such as Chronic Obstructive Pulmonary Disease (COPD) and silicosis, accounts for a significant proportion of work-related ill health and so the DRP has a specific project to address this. This Silica Baseline Survey (SBS) has been performed to support the respiratory disease project as exposure to Respirable Crystalline Silica (RCS) is recognised as a significant potential cause of respiratory disease.

Crystalline forms of silica (Quartz, plus the much less common minerals cristobalite and tridymite which form at high temperatures) are the commonest minerals in the earth's crust (matched by the feldspar group, according to some authors.) Quartz therefore forms a proportion of many materials that are either extracted from quarries and used as raw materials in industries such as pottery, brickmaking or stonemasonry, or likely to be disturbed and released from materials in the course of construction. When silica-containing materials are crushed or abraded the silica crystals are split or shattered to release fragments of a range of sizes. Most significantly, a proportion of them are sufficiently small that if they are inhaled they evade the various air-cleaning mechanisms of the human respiratory tract and penetrate to the depth of the lung where gas-exchange takes place. Particles of this size range are termed "respirable" and are known to be associated with disease.

2.1 HSE SILICA BASELINE SURVEY

HSE has implemented a number of actions under the DRP to reduce the prevalence of work-related ill-health, targeted at selected diseases and then at the specific causes of these diseases. Silicosis and similar respiratory illnesses continue to occur among the working population and are considered to be sufficiently important to merit a variety of interventions to reduce incidence.

Most ill health resulting from RCS inhalation occurs after prolonged exposure or a considerable time after the exposure. It is not therefore possible to assess the effectiveness of an intervention by looking at the reduction in the incidence of disease within a 5- or 10-year period. However if RCS *exposure* can be shown to fall after an intervention then the incidence of disease in the future can be expected to decrease. There are several difficulties associated with this approach, however. One is that measurements of exposure really only reflect the conditions during the period during which the samples are collected, when operatives are under observation and probably more conscious of work procedures. Monitoring visits are also almost always made by appointment, which provides the opportunity to ensure that exposure controls are functioning as well as possible. It would also be quite impracticable to collect enough data to provide a robust assessment of exposure across a number of industries, some very large. In the light of the fact a relatively small number of measurements of exposure give a limited view of the effectiveness of exposure controls, the SBS has adopted in parallel a method of assessing another aspect of the effectiveness, i.e. the robustness of exposure controls.

The aims of the baseline study also included the acquisition of intelligence from individual companies, trade associations, consultants and other sources to supplement the limited data held within HSE. The study will allow "benchmarking" where data and intelligence already exist.

In addition, the study will have helped initiate the process of raising awareness and intervention. It will also provide Occupational Hygiene intelligence to assist in the setting and implementation of the Workplace Exposure Limit (WEL) for respirable crystalline silica.

The HSE Silica Action Plan aims to focus on those industry sectors where a substantial proportion of exposures currently exceed 0.1 mg.m^{-3} and to work with these sectors to bring exposures to below 0.1 mg.m^{-3} . These sectors include: -

- (i) Brick making (including tile making)
- (ii) Quarries
- (iii) Construction
- (iv) Stonemasonry

Many hundreds of thousands of people work in these sectors of UK industry. This, when combined with the concerns in HSE that many of these workers are exposed to RCS above 0.1 mg.m^{-3} (in some cases possibly quite markedly) justifies the decision to focus resource and effort in these sectors.

This report draws together the main points from the reports of the work in the four sectors. It was not the intention to compare the performance of the sectors or to draw comparative conclusions, although some common themes emerged. Full details of the SBS work in each of the sectors are shown in the sector-specific annexes to this report, including summaries of the control assessment site visits, exposure data and discussion of other relevant research.

2.2 INFORMATION SOURCES

A variety of sources of information have been used during this study. These have included:

Office for National Statistics (ONS) “UK Standard Industrial Classification of Economic Activities 2003 – SIC (2003.)”

ONS 2005 analyses of UK business and employment statistics: Business: Activity, Size and Location – 2005,

HSE Manufacturing Sector (Metals & Minerals sub-sector)

THOR Research Associate, Centre for Occupational and Environmental Health, The University of Manchester

British Geological Survey web pages

Various sector-specific resources such as trade association websites.

2.3 HEALTH EFFECTS OF EXPOSURE TO RCS

Exposure to RCS can result in a variety of forms of damage to the respiratory system as the fine dust particles penetrate deep into the lungs, potentially causing the following adverse health effects: -

Silicosis – A slow, progressive, irreversible disease that usually develops many years after initial exposure. Symptoms include chronic cough, phlegm and mild to serious breathing difficulties. In severe cases death can ensue. Silicosis is diagnosed by chest X-ray where the

presence of rounded nodules of scar tissue on the lungs is visible as white opacities. The highest risk of developing silicosis is from exposure to the freshly fractured fine particles of RCS that are generated during many common workplace tasks such as drilling, cutting, grinding, polishing etc.

Acute Silicosis – People who experience exceptionally high exposures over a few months or years can develop this rapidly progressive and often fatal condition (after exposures in the order of 1.5 mg m⁻³ on a daily basis for a year or two). This can result in death within a few years of exposure.

Lung cancer – Heavy and prolonged exposure to RCS under the conditions that produce silicosis can cause lung cancer;

Chronic Obstructive Pulmonary Disease (COPD) – This is an umbrella term that covers emphysema and chronic bronchitis. It is characterised by airflow limitation and is not fully reversible. The symptoms are the same as for silicosis - cough with phlegm, wheezing and breathing difficulties and it too can result in death.

2.4 RESPIRATORY DISEASE – EPIDEMIOLOGICAL DATA

The available data on the incidence of silicosis in the UK is incomplete, but there are several indicators of the potential scale of the incidence of the disease.

The DWP Industrial Injuries and Disablement Benefit (IIDB) scheme maintains records of the new cases of disablement benefit. The cases of "other pneumoconiosis" (which will be mainly silicosis) number about 80 cases per year, although there can be considerable year-to-year variation, with 150 cases in 2002. The 5-year moving average has been approximately 90 for the last 5 years for which figures are available as shown in the table below. (Source: Regulatory Impact Assessment (RIA) ref HSE 2003, see also <http://www.hse.gov.uk/statistics/causdis/pneumoconiosis/index.htm>).

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
No. of cases	40	45	70	90	65	75	150	80	60	85	70
5-year moving average:					62	69	90	92	86	90	89

HSE sponsors the Health and Occupation Reporting Network (THOR) at Manchester University. Recent data obtained from THOR regarding cases of respiratory disease attributed to silica (recorded under the Surveillance of Work-Related and occupational Respiratory Disease, or SWORD) in the years 1989-2005 indicated that there were 763 estimated cases and 422 actual cases of silicosis in the period (Ref THOR.) The report is included as appendix D to this report.

Data from the Occupational Physicians Reporting Activity (OPRA) (1996-2005) regarding cases of respiratory disease attributed to silica estimated 27 cases and reported 5 actual cases. 24 of these 27 cases were attributed to the 'Manufacture of other Non-Metallic Mineral Products' industry (Division 26 - SIC classification). This industry division includes the Construction and heavy clay industries as well as stonemasonry (another industry where high exposures to RCS are frequently encountered).

Both the IIDB and THOR data sources are likely to substantially underestimate the incidence of silicosis. Silicosis is probably a necessary cause for silica-related lung cancer and the current

burden of lung cancer due to past exposures to silica in construction alone could result in more than 500 deaths per year (Rushton et al, 2007, (page 63 Fig 9.)) This figure suggests that the extent of the underestimation of silicosis could be very considerable. The risk estimate for silicosis for those with 15 years exposure to silica at the current (2006) WEL reported in the Regulatory Risk Assessment also implies a much higher figure than recorded in the available statistics.

Fatal silicosis (silicosis that leads to premature death)

Over a sixty-year period, HSE predicts that the following number of silicosis fatalities would be prevented at the various proposed exposure limits:

Exposure Limit (8hr TWA)	Deaths
0.3 mg.m ⁻³	36 fatalities / 1 PA
0.1 mg.m ⁻³	185 fatalities / 3 PA
0.05 mg.m ⁻³	300 fatalities / 5 PA
0.01 mg.m ⁻³	455 fatalities / 8 PA

Source: Regulatory Impact Assessment (RIA) (HSE2003) Paragraph 60

2.5 EXPOSURE LIMITS

In the UK exposure to RCS is regulated under the Control of Substances Hazardous to Health (“COSHH”) Regulations 2002 (as amended) (HSE 2002 and 2004.) There is a duty to apply the “Principles of good control practice” listed in schedule 2a of the Regulations and exposure should not exceed the Workplace Exposure Limit (WEL) set in EH40, (HSE 2005.) The WEL that applied at the start of this project was 0.3 mg.m⁻³ and it was reduced to 0.1 mg.m⁻³ in October 2006. The new limit was included in the updated List of approved workplace exposure limits published by HSE in 2007 (HSE 2007).

The European Network for Silica (ref NEPSI) [<http://www.nepsi.eu/home.aspx>] is formed of interested employer and employee organisations. A number of Industry Sector Associations have made binding agreements to implement the requirements of the Social Dialogue Agreement for silica (SDA) which is a broadly parallel initiative to nationally-set exposure limits. It requires the implementation of both the exposure monitoring and reporting protocol and the associated “good practice guides.” The good practice guides are similar to the COSHH Essentials guidance published by HSE and, if implemented in full, should result in exposures below the WEL. Although the SDA is not binding on employers who are not members of the participating trade associations, the nature of NEPSI makes it clear that all the actions suggested in the guidance are acknowledged as practicable by employers, and other organisations should therefore also be able to adopt the same standards.

In the UK the SDA applies to those companies in the quarry industry that are members of or affiliated to the QPA or to Eurocoal (open-cast coal producers,) and to those in the brick and heavy clay industry affiliated to the British Ceramic Confederation. No UK Construction or Stonemasonry employers are affiliated to associations which are signatories at the European level.

2.6 TECHNICAL BACKGROUND: SILICA AND ROCK TYPES

As one of the commonest and most stable rock-forming minerals, silica is found in most strata, although in differing proportions. It is one of the three principal constituents of granite, perhaps the most familiar igneous rock, formed from the slow crystallisation of magma within the

earth's crust. If molten rock of the same composition cools relatively rapidly nearer the surface a micro-granite with small crystals forms. However if lava of the same chemical composition is chilled rapidly a non-crystalline volcanic glass, obsidian, is formed instead. With the exception of obsidian, all the rock types will generate crystalline silica fragments when they are fractured. Magmas contain a wide range of silica contents: as it falls the rock produced are said to become less "acidic." Rocks with negligible quartz content are called gabbros, dolerites and basalts in decreasing order of crystal size. Most types of igneous rocks are extracted for use as aggregate or railway ballast because of their strength and hardness.

Silica grains (or larger particles) eroded from igneous and other rocks by natural processes are ultimately incorporated into sedimentary rocks. A degree of winnowing usually occurs before deposition, which may be from the air or in fresh or salt water. The grains may be cemented by a variety of minerals which are subsequently deposited from the circulation of groundwater over geological time, often at relatively high temperature and pressure. An uncemented deposit consisting only of quartz grains with no other mineral content (such as iron compounds) is called silica sand and is highly prized as a chemical feedstock and for glass making. Rock containing only quartz grains is termed an orthoquartzite and may be cemented by quartz too. Sandstones are common rocks and, as long as they are not too poorly cemented, are useful as building stones or may be crushed for aggregate. They have generally been laid down in desert environments or on coastal shelves as the grain size is such that settlement occurs rapidly. Deltaic fans built up from sediments at river mouths produce layers of sands and mud to form a rock known as greywacke, which may contain evidence of reworking and collapses into deeper water. Uniformly fine-grained sediments will normally have been laid down in still water environments such as lakes or deep seas. In broad terms the finer grained sedimentary rocks are called clays, shales or mudstones depending on grain size, the other minerals present and how they cleave.

Sedimentary rocks formed by other mechanisms, e.g. evaporites such as rock salt and gypsum deposits, and limestone formed from the accumulation of calcium carbonate in relatively deep-sea conditions, all have the potential to contain very fine-grained silica crystals. Chalk is deposited in seawater at intermediate depth (principally from the calcareous tests of small animals from the plankton) but also contains sponge spicules and the skeletons of radiolaria, both siliceous. At the higher pressures which pertain in deeper water the carbonates dissolve, leading to the accumulation of a siliceous ooze, while at the greatest depths even the silica dissolves and the only sediment consists of clay minerals. When the outer edge of the continental shelf becomes unstable an area of uncompacted or uncemented sediments may slump and flow into the ocean depth as a turbidite. Thus even these deep-sea sediments, when converted to rock, will contain silica which may become airborne as RCS during crushing etc. Silica forms the greater part of chert and flint, but in these cases it has formed by precipitation from groundwater *in situ* and is described as cryptocrystalline, i.e. it has crystals too small to see by traditional geological methods, but it is not amorphous. Grinding calcined flint for the pottery industry was at one time a serious cause of silicosis and one of the earliest recognised industrial diseases.

All rock types when buried in the crust are subject to alteration with time, and whatever the starting point the commonest change is probably the deposition of silica from groundwater. The silica may act as a cement between grains of quartz or other minerals, it may form crystals within the body of the rock or it may precipitate out in lenses, veins or sheets. Older rock formations are most likely to have been altered in this way, and therefore to generate airborne silica when crushed, even if the base rock did not contain a high proportion of silica.

Many industrial processes use earth-derived raw materials. From the distribution of silica described above it is clear that the extraction, processing and in some circumstances the use and

final disposal of products will have the potential to cause RCS exposure if the silica is fragmented and released.

2.7 EXPOSURE MECHANISMS

When raw materials are extracted from the ground access usually has to be gained to the strata of economic interest. Any topsoil and subsoil and overlying strata are removed and either stockpiled for use during remediation, used for this purpose immediately or removed from the site. All this material is likely to contain a greater or lesser proportion of quartz depending on its geological nature or derivation. Disturbance can lead to RCS exposure, especially in dry weather. It is commonly a consequence of the re-suspension of dust from contaminated haulage routes by vehicle wheels and this RCS generation mechanism exists throughout most stages of production in most quarries. A process directly comparable to this is also present in many other industrial environments and at some stage on most construction sites.

Stone extracted for use as aggregate is reduced to the desired sizes in a succession of crushers which usually feed screens to separate the size fractions. The action of crushing rock may generate large quantities of fine dust which may become airborne either immediately or in the course of transfer between processes (e.g. at conveyor transfer points.) Screening also represents a major source of dust emission as energy is applied in the course of the process, releasing the rock fines. Movement of the products on and off stockpiles and into lorries or other transport presents further opportunities for dust release. Again, similar processes create the potential for RCS exposure in the construction industry, both on sites and at suppliers' yards and at rubble recycling facilities.

The brick and heavy clay industry take clay or other clay-rich sedimentary rock and process it, often via a drying and grinding stage, to a point where it is wetted to achieve the correct water content for the plasticity required, then extruded. It can be wire-cut to give blocks ready for firing at this stage, or it may be subject to other pressing or shaping processes. Although it is damp at the point of shaping, any spillage is vulnerable to drying out and the subsequent release of respirable dust including RCS if routine cleaning is inadequate. Sand and pigments are commonly applied to the damp clay surfaces as a means of producing particular surface finishes, often via a compressed air jet. This process and associated spillage also presents a route by which RCS can be released. After firing the now dry and relatively brittle bricks are likely to generate dust as abrasion of the silica-containing masses occurs each time they are handled, moved or stacked.

Stonemasonry is by definition the shaping or re-shaping of materials derived from the earth's crust. Most of the processes involve the removal of stone, whether it is sawing blocks to give sheets, further reducing, shaping or polishing the sheets or the application of decorative or other detail. Most removal processes generate fine particulate, whether from the abrasion by cutting tools or from the fracturing of quartz crystals as flakes are broken off the work-piece. Few types of stone do not contain some crystalline silica and working most (including limestones or marble) will therefore release RCS unless the process is operated to eliminate the hazard. Some water-cooled processes apply sufficient energy that water droplets of respirable size containing silica particles can be generated which thus still represent an RCS inhalation exposure risk. Similar processes occur during construction, where concrete, stone and brick products are cut to size, and at some brick producers who "make" bricks of particular shapes by sawing and joining fired standard bricks.

In general, if sufficient energy is applied in the course of a process which necessarily or incidentally causes fracturing of silica grains and if a control mechanism is not applied (or fortuitously present) then generation and subsequent inhalation of RCS is likely. This occurs

widely throughout the construction industry and may be illustrated by a simple example. A hole may be drilled in a wall, e.g. for a fixing or to pass a cable or pipe, by a hammer-drill and masonry bit. First plaster may be penetrated, then brick or concrete blocks bedded in cement mortar. The plaster will probably have been made from gypsum which originally formed by evaporation in a shallow sea and therefore may contain a little crystalline silica. Similarly the bricks are usually made from clay, a marine or lake sediment also probably containing quartz, while the concrete blocks and cement mortar are almost by definition quartz-containing sand or larger aggregate grains bound in a cement paste matrix. One type of brick is made entirely of pure silica sand bonded by calcium silicate. The generation of dust from any of these materials has the potential to generate a RCS inhalation hazard.

Maintenance and alteration in construction often require activities that generate particulate from existing structures. An existing structure is often roofed, and therefore thoroughly dry within. When walls are cut or a building's surface is cleaned by means of a jet of abrasive a large amount of dust is generated. Disc-cutting exterior mortar by the use of abrasive wheels and grit-blasting both generate very high dust levels, and both processes involve the removal by minute increments of mortar or stone/brick (which may both have a significant silica content.) Both these activities were examined for the SBS.

3 SITE ASSESSMENT METHODOLOGY

3.1 SITE SELECTION

One of the principal objectives of the study was to obtain baseline occupational hygiene data and information relating to exposure to respirable crystalline silica in 4 industrial sectors.

In order to achieve this within the time-frame and budget for the study, a limited number of sites undertaking activities known to pose a significant risk of exposure to RCS were selected for monitoring visits.

Office of National Statistics (ONS) data was consulted to explore the breadth of the industries and to help identify high-risk activities, besides using existing HSE intelligence and various further inputs as described in the sector paragraphs that follow.

After a sufficient number of suitable sites had been identified in each industry those selected for inclusion in the survey, with the exception of those previously visited by HSE, were chosen at random. The baseline studies field survey visits were as follows:

Industry Sector	Number of sites	Date of visits
Brickworks	10	April 2005 to May 2006
Construction sector	12	December 2005 to May 2007.
Stonemasons	14	April 2005 to May 2006
Quarry operators	8	December 2005 to May 2007.

Note: the SBS discussions includes data gathered during 8 HSE visits made for other purposes (1 Brickworks and 7 Stonemasons.)

The majority of sites volunteered to participate in the survey. Some sites were visited with a representative from HSE FOD.

3.1.1 Brickmaking

The study sites were selected to include a variety of characteristics including

- Known examples of conspicuously good or bad hygiene practice:

A number of sites had been previously visited by HSE representatives and these included sites where particularly good or bad hygiene practice had been identified. Good practice included innovative or well-designed engineering controls, good health & safety management, etc. Bad practice included evidence of over-exposures, ineffective or poorly designed engineering controls and poor health & safety management.

- A range of brickmaking methods

The range of different production processes were covered, namely hand made brick, extrusion and the Fletton process and also the Ashler process, akin to concrete brick production.

- Brickmaking businesses of differing size and capacity

The UK brickmaking industry has gone through considerable consolidation over recent years and a large number of the UK brickmaking facilities are now part of large multi-site corporations. The survey attempted to include brickmaking facilities that reflected the different range of businesses in the industry, from large multi-site operations to small, independents.

3.1.2 Construction

Due to the nature of the industry's structure (composed of large numbers of small and micro-businesses as well as large organisations) a comprehensive survey to identify the distribution of good and bad hygiene practice across the construction would have been difficult and very expensive. The principal focus was therefore on businesses whose operations involved construction activities known to pose significant risk of exposure to RCS, in particular:

- Businesses utilising plant & equipment capable of generating significant concentrations of dust (e.g. hand-held power tools).
- Activities where developments in dust control technology may have led to the possibility of reductions in RCS exposures.

Initial discussions with businesses were undertaken in order to determine the type and standard of any engineering control measures employed to deal with dust hazards. In considering their exposure control strategies good practice was identified by items such as innovative or well-designed engineering controls, good health & safety management etc. Bad practice included evidence of overexposures, ineffective or poorly designed engineering controls and poor health & safety management.

Information published by the UK Office of National Statistics (ONS) was consulted to explore the breadth of the industry and to suggest high-risk activities. Construction forms Division 45 of the ONS "UK Standard Industrial Classification of Economic Activities 2003 – SIC (2003)." The very large range together with the details of the subdivisions within Division 45, Construction is shown in Appendix C.

The Construction activities selected for monitoring visits were highway (footpath) maintenance, concrete recycling, blast cleaning, mortar removal and tunnelling operations. Although relatively few visits were made and in other workplaces RCS control might differ from the standards seen, the number of sites was adequate to allow the examination of issues relating to exposure control.

Construction businesses of differing size and capacity were included, ranging from small businesses through a local authority Direct-Labour Organisation to the concrete-recycling plants of a business with a nationwide presence.

3.1.3 Stonemasonry

A range of factors were considered when selecting sites, including:

- Known examples of good or bad hygiene practice.

A number of sites had been previously visited by HSE representatives and these included sites where notably good or bad hygiene practice had been identified. Good practice included; innovative, well-designed engineering controls, good health & safety management etc. Bad practice included evidence of over exposures, ineffective or poorly designed engineering controls, poor health & safety management.

- A range of classical and emerging stonemasonry activities

Long-established stonemasonry activities such as headstone production, ornamental masonry and building restoration were included alongside emerging activities such as the production of kitchen worktops.

- Use of stone with significant silica content

Sites which worked with stone known to contain significant silica content e.g. sandstone, granite etc. were selected. The volume of work with high-silica stone was not known during selection and as a result the volumes varied considerably between sites. Some sites worked exclusively with high silica stone and others worked principally with low silica stone but occasionally worked with medium silica content stone such as granite.

After a sufficient number of suitable sites had been identified the sites selected for inclusion in the survey, with the exception of those previously visited by HSE, were chosen at random. The majority of sites volunteered to participate in the survey. Some sites were visited with a representative from HSE FOD.

The following gives a summary of the stonemasonry sites selected for inclusion in the Silica Baseline Survey

HSE FOD (NE) Region (All sites used granite and limestone):

- 3 producing kitchen work surfaces
- 1 making stone fireplaces, kitchen tops and cobbles
- 2 involved in headstone production

“Midlands:”

- 3 producers of bathroom & kitchen work surfaces (granite and limestone)
- 1 manufacturer of stone fireplaces, kitchen tops and cobbles
- 2 producers of sandstone walling blocks, paving slabs and bespoke masonry items
- 1 undertaking building restoration in sandstone and limestone
- 1 producing architectural items window & door surrounds
- 1 making bathroom & kitchen work surfaces (granite-containing composite stone)
- 1 producer of stone fireplaces (marble & granite)
- 2 sites were visited twice; one following improvements and a second following relocation of business and expansion of stonemasonry work.

3.1.4 Quarry industry

Quarries were selected by criteria including:

- Extraction of stone of types prioritised by silica content
- Preferably not members of a large industrial grouping
- Quarrying businesses of differing size and capacity

The UK quarrying industry has gone through considerable consolidation over recent years and a large number of the UK quarries facilities are now part of large multi-site corporations. The survey attempted to include quarrying facilities that reflected the range of businesses in the

industry from large multi-site operations to small, independent concerns, but weighted towards the smaller employers.

It was therefore decided that to acquire exposure data and an assessment of control and RPE competence within the initial remit of 8 sites, the work would focus on producers of higher-silica materials. It was considered that as sand production involved minimal crushing and the handling and screening was of particles of small mass inherently less likely to generate RCS as a consequence of impacts with each other, producer sites would be given a lower priority.

The primary focus of the visits was therefore to sites extracting either stone with a high intrinsic silica content, or where the age of the stone was such that high secondary mineralisation with silica would be anticipated. This approach led to the selection of quarries working the following rock types:

- Olivine-dolerite (medium grained basic intrusive igneous rock) with extensive quartz veining
- Greywacke of Carboniferous age
- Carboniferous (Pennant) sandstone
- Aggregate production from North Wales slate
- Roofing slate production
- Extraction of large blocks of New Red Sandstone for dimension stone production
- Open-cast coal production (where more than 90% of the stone moved is sandstone) and
- Two sister sites producing sand which were visited primarily for another project.

After a sufficient number of suitable extraction sites had been identified those selected for inclusion in the survey, including a few that had previously benefited from HSE intervention, were chosen at random. Advantage was taken of work proceeding on another project to make joint visits. These were at a quarry extracting Pennant sandstone and at another producing sand. The other work was measuring the RCS concentration at the quarry perimeter as part of an assessment of the risks from third-party exposures.

3.2 COMPETENCY DESCRIPTORS FOR EXPOSURE CONTROL AND RPE

Where work with or generating a hazardous substance cannot be sidestepped (e.g. by adopting a different process, or by the substitution of a less harmful substance) the preferred method to eliminate or reduce a health risk that results from inhalation exposure is to apply engineered controls. These range from complete enclosure of the process to the application of various patterns of Local Exhaust Ventilation (LEV). When it is not possible to apply engineered controls Respiratory Protective Equipment (RPE) provides an alternative method of preventing inhalation of contaminants. However it is recognised that both approaches are susceptible to failure for a wide variety of reasons.

Engineered controls are often found to be of a design that is quite inappropriate for the need and even if it has been correctly specified, the details of design or installation may prevent it functioning effectively. Most types are vulnerable to failure if maintenance is neglected and some types of LEV depend critically on the care with which the operator positions the captor hood relative to the (possibly moving) source of contaminant emission. The generation of RCS from work with earth materials is almost inevitable in many processes and the application of engineered controls is therefore a necessary measure. However there is a tendency to “fit and forget” control measures and there is therefore significant potential for failure of engineered exposure control measures.

It is a truism to say that to function effectively RPE also needs to be correctly specified, maintained and used. It is potentially more vulnerable to failure than engineered controls because after procurement and storage it has to be donned whenever needed by the user (which does not always happen) and worn in such a way that it achieves a satisfactory face-fit, often ultimately reliant upon an adequately clean-shaven face. It is thus dependant upon the diligence of the individual and without this the RPE cannot give the desired protection. This is of major importance because RPE is the last line of defence against exposure.

For these reasons the overall effectiveness of exposure control was not judged simply by measurement of exposures, but an assessment was made of “control competence.” This concept addressed the underlying reliability of the wide range of measures that underpin an exposure control strategy. Competency descriptors have been developed to allow a structured assessment to be made of the adequacy both of engineered controls generally and of the use of RPE. The views and professional opinion of the visiting Occupational Hygienist were captured in a way that allowed an objective assessment of control competence to be made. The same criteria could then be also used at some future date to judge change if needed: where control is currently considered to be inadequate a shift in the profile of these indicators would provide strong evidence of the desired improvements in the industries. The range of factors forming the checklists can be found in Appendix B (RPE competency and Control competency descriptors) and the factors themselves are described below:

“Control competence” was assessed by

- Comprehensiveness of COSHH assessment
- Awareness of literature and information sources
- Application of appropriate, effective, well maintained controls at process
- Degree of management and operator understanding of exposures
- Level of operator training
- Designation of areas and use of RPE when appropriate
- Well informed management
- Competence of supervision

i.e. overall evidence of a coordinated approach to control with skills and knowledge available.

“RPE competence” was assessed by

- Verifiable policy on RPE linked to COSHH assessment.
- Face fit testing programme
- Equipment routinely available and range of products available through selection process
- Appropriate storage facilities
- Initial operator training and refresher training
- Operator understands role of RPE in controlling exposure
- Clearly defined roles and responsibilities

Achievement of a rating of 4 for control competence and, if necessary, for RPE competence, was intended to identify sites which “achieved the COSHH Essentials standard.” This indicated a system of exposure control sufficiently robust that ongoing compliance with the WEL could be anticipated. A grade of 5 would have indicated exemplary performance in every aspect of control but was not seen anywhere.

3.3 EXPOSURE MEASUREMENTS

General

In general, personal monitoring was undertaken in accordance with approved inhalation exposure monitoring strategies described in the Health and Safety Executive publication HS(G)173 - Monitoring Strategies for Toxic Substances.

For each field study personal monitoring was conducted in areas where the operations were deemed to offer the greatest risk of exposure to airborne RCS. For comparison purposes, sampling was also conducted on operatives and in locations that had been included in the dutyholders' exposure monitoring.

Background levels of respirable dust and respirable crystalline silica in the work area atmospheres were measured at strategic static locations in a similar manner.

Occupational Exposure Monitoring Methods:

Respirable dust was measured by drawing air at a defined flow rate ($2.2 \text{ l}\cdot\text{min}^{-1}$) through a pre-weighed membrane filter held in a cyclone sampling head. The flow rate for the pumps was measured and recorded prior to the start of the sampling and re-checked periodically and again at the end of the sampling. The filter heads were mounted in the operative's breathing zone, e.g. suspended from the lapel of the overalls and as close as possible to the nose and mouth.

All samples were analysed at the UKAS-accredited Health & Safety Laboratory (HSL), Buxton. Crystalline silica was quantified by X-ray diffraction (XRD) techniques.

Table: Sampling and Analytical Methodologies used in this Investigation:

Hazardous Substance	Method Reference	Analytical Technique
Respirable dust	MDHS 14/3 (General methods for sampling and gravimetric analysis of respirable and inhalable dust)	Gravimetric analysis
Respirable Crystalline Silica (RCS)	MDHS 51/2 (Quartz in respirable airborne dust) and MDHS 101 (Crystalline silica in respirable airborne dusts)	X-Ray diffraction

MDHS – Methods for the determination of hazardous substances

3.4 FOLLOW-UP QUESTIONNAIRE

The poor control of exposure and underlying competence found at the locations visited in the stonemasonry sector prompted a supplementary further enquiry by a questionnaire administered by telephone. It was to investigate the level of understanding of aspects such as current legislation, the health effects of RCS exposure and the availability of guidance etc. The form is shown as Appendix E.

4 RESULTS

4.1 GENERAL COMMENTS

Summaries of the data generated for each sector during the SBS are shown as tables 1 to 4 in Appendix A of this report. Extracts from the site visit reports and details of the exposure data are shown more fully in the Sector Annexes to this report (references.....r

4.2 BRICKMAKING

Control and RPE competence assessments

Of the 9 brickmaking sites awarded a rating for adequacy of control measures 4 sites achieved a rating of 4, i.e. achieved a level of control that would be deemed appropriate in accordance with COSHH Essentials. The remaining five sites received ratings of 3. One site was trying to complete the commissioning of water-spray dust suppression, but had to postpone the assessment visit until after the sampling phase of this work, and thus was not visited.

The average rating awarded across the nine sites was slightly better than Rating 3, which can be summarised as '*Occasional over-exposure. Reasonable awareness of hazard and risk and desire to improve.*' This summary of control could be considered to appropriately reflect the overall picture of the industry obtained from this study.

Of the 7 sites awarded a rating for adequacy of RPE, no sites achieved a rating of 4, i.e. achieved a satisfactory standard where there was strong evidence of selection of suitable and adequate equipment and good practices in use.

Three sites achieved a rating of 3 and the remaining five sites were awarded a rating of 2. One site was not awarded a rating as RPE was neither provided nor utilised.

The average RPE rating awarded across the eight sites was slightly better than Rating 2, i.e. '*RPE used to achieve adequate control. Evidence of provision of suitable and adequate equipment but strong evidence of poor practices in use.*'

The principal issue identified with the provision and use of RPE was the lack of face fit testing conducted. Regulation 7 of COSHH states that the initial selection of RPE (full / half face masks including disposables) should include fit testing to ensure that the correct device has been chosen (in terms of size and fit etc.). All site H & S managers to whom this non-compliance was identified said that they would address this issue as soon as possible or that they had already taken steps to achieve compliance.

Exposure monitoring:

The results of worker exposure measurements made during the SBS (n= 97, plus 45 static measurements) show that approximately 30% had exposures that exceeded 0.1 mg.m⁻³ 8hr TWA. Industry responses to the questionnaire circulated in 2003 before the RIA was prepared considered that approximately 24% of personnel might be potentially exposed above 0.1 mg.m⁻³ 8hr TWA.

Thus the results of the SBS indicate that the most recent industry estimates of the number of employees within the brick making sector exposed to RCS above the proposed revised WEL of 0.1 mg.m⁻³ 8hr TWA was rather optimistic and a significantly higher number of staff are potentially at risk of unacceptable exposure.

4.3 CONSTRUCTION

Control and RPE competence assessments

Of the 8 sites awarded a rating for adequacy of control measures, 3 sites achieved a rating of 4, i.e. achieved a level of control that would be deemed appropriate in accordance with COSHH Essentials. One was allocated 3 and the remaining four sites received ratings of 2.

Control Competence Rating:	0	1	2	3	4	5 (exemplary)
Number of sites:			4	1	3	

(Range: 0, “Manifest failure to recognise hazard and failure to provide any form of controls,” 4: The COSHH Essentials Standard, 5: Exemplary control consistent with risk. Detail in Appendix D)

The average rating awarded across the eight sites was Rating 3, which can be summarised as ‘Occasional over-exposure. Reasonable awareness of hazard and risk and desire to improve’ This summary of control could be considered to appropriately reflect the overall picture of the industry obtained from this study. Although the result of a very small sample, the bimodal distribution is noteworthy.

Of the 7 sites awarded a rating for adequacy of RPE, no sites achieved a rating of 4, i.e. they did not achieve a satisfactory standard where there would have been strong evidence of selection of suitable and adequate equipment and good practices in use.

RPE Competence Rating:	N/R	1	2	3	4	5 (exemplary)
Number of sites:	1		5	3		

(Range: N/R RPE not required, 1, “No evidence of use or provision” 4: “RPE used to achieve adequate control,” 5: Exemplary RPE programme. Detail in Appendix D)

Three sites achieved a rating of 3 and the remaining five sites were awarded a rating of 2. One site was not awarded a rating as RPE was neither provided nor utilised.

The average rating awarded across the eight sites was Rating 2, i.e. ‘RPE used to achieve adequate control. Evidence of provision of suitable and adequate equipment but strong evidence of poor practices in use.’

The principal issue identified with the provision and use of RPE was the lack of face fit testing conducted. Regulation 7 of COSHH states that the initial selection of RPE (full / half face masks including disposables) should include fit testing to ensure that the correct device has been chosen (in terms of size and fit etc.). All site H & S staff to whom this non-compliance was identified said that they would address this issue as soon as possible or that they had already taken steps to achieve compliance.

Note: No rating was made at any site where RPE was neither provided nor utilised. None of these sites had a standard of control deemed appropriate in accordance with COSHH Essentials i.e. all were awarded competency ratings of lower than 4. Therefore it can be deduced that the reasons that RPE was not introduced may have been because of a false assumption that existing control was satisfactory at these sites.

Exposure monitoring:

Of 29 personal measurements of exposure made during the study, 4 (or 14%) indicated 8-hour TWA exposure above the (2006) WEL of 0.1 mg.m^{-3} RCS. All 4 samples came from different sites: 2 were taken during the removal of mortar prior to repointing buildings, one was from a concrete recycling plant and the other was taken during the grit-blasting of a sandstone building façade. This reflects the observations of control competence, in that the inability to adequately “engineer out” exposure in over half the sites visited would be expected to have influenced exposures. Two assessments of exposure made during tunnelling work indicated that with the installed dust suppression on the equipment, rock drilling would not be likely to cause exposure above the WELs for RCS. Shotcreting, however, generated particulate that might cause exposure to respirable dust above the WEL.

In the rest of the survey 4 samples also revealed exposure to respirable dust above 4 mg.m^{-3} , the threshold at which it becomes a “Substance Hazardous to Health” and thus within the scope of the COSHH regulations. These samples were all from building restoration or maintenance operations, characterised by small peripatetic teams often working as franchisees of organisations with a national presence principally in a marketing role or supplying equipment.

4.4 STONEMASONRY

Control competence assessments

Of 14 stonemasonry sites rated for control competence, the majority were given classifications of 0 or 1. This was in the context of “evidence of unacceptable levels of over-exposure” when judged against the criterion of the exposure which applied at the time of the visit, i.e. a WEL of 0.3 mg.m^{-3} , and negligible exposure controls or inadequate maintenance of any that existed.

Control Competence Rating:	0	1	2	3	4	5 (exemplary)
Number of sites:	1	5	2	2	1	0

One site was revisited 7 months after an initial visit revealed competence of 0: conditions were barely improved by then (control competence improved to “1”) and the respirable dust exposure was still excessive, although the stone being worked was generating minimal RCS.

Almost none of the sites had made a thorough assessment of the consequences of silica exposure as required by COSHH. This was one of the factors involved in the low “Control competence” ratings they received, but equally was probably a part of the reason why their control competence was so low.

RPE competence assessments

Two sites were considered not to require RPE to achieve control of exposures. One site was allocated a rating of “1”, one other “4” and 9 were allocated “2,” which indicates adequate control by RPE, but very little resilience in terms of the expertise with which it was used or confidence in the likelihood of ongoing effectiveness in the longer term. The single site rated 4 was the location that also achieved a “4” for control competence.

RPE Competence Rating:	N/R	1	2	3	4	5 (exemplary)
Number of sites:	2	1	9	0	1	0

Exposure monitoring:

Of 94 personal measurements of exposure 18%, indicated 8-hr TWA exposure to RCS above the WEL of 0.3 mg.m⁻³ which applied when the measurements were made and a total of 39 (41%) were above the more recent limit of 0.1 mg.m⁻³.

20 measurements (21%) indicated exposure to respirable particulate above 4 mg.m⁻³ and 3 of these were when low-silica stone was being worked. If stone containing a significant proportion of silica had been in use during the monitoring it is probable that these samples would also have shown unacceptable RCS exposure, further increasing the numbers mentioned above.

Verbal follow-up questionnaire

The responses to the questionnaire are shown in detail in table 9. A summary of the totals is shown below.

Questions:	WEL:		Control	Know/have guidance?				Know diseases?			Want info via:	
	Aware of reduction?	Know new?	Improvements planned?	HS (G) 201	INDG 315	COSHH	COSHH & Silica essentials	Silicosis	Lung cancer	Copd / emphysema	Internet?	post?
Total Y:	4	1	2	6	2	10	6	4	1	5	13	13
Total N:	10*	3	1	7	11	3	7	9	12	8	0	0
			1 “Poss”					Plus 3 guessed “lungs”				

*One company stated that they were no longer working stone and are included only in the total of 10 who did not know of the impending reduction in the WEL for RCS.

4.5 QUARRY INDUSTRY

Control competence assessments

Of the 7 quarry sites awarded a rating for adequacy of control measures, one achieved a rating of 4, i.e. achieved a level of control that would be deemed appropriate in accordance with COSHH Essentials and 3 were allocated a “3”. The remaining four sites received ratings of 1 or 2.

Control Competence Rating:	0	1	2	3	4	5 (exemplary)
Number of sites:		1	3	2	1	0

The average rating awarded across the nine sites was between 2 and 3, which can be summarised as between ‘Evidence of over-exposure. Some understanding of hazard and risk and some controls in place but not receptive to need to improve’ and “ Occasional over-exposure. Reasonable awareness of hazard and risk and desire to improve.

It was noticeable that very few sites addressed the need to control exposure to RCS via a formal COSHH Assessment or a section dealing with silica inhalation in a broader RA. All were aware of the consequences of exposure, most addressed it during staff induction and almost all operated Occupational Health Surveillance. Most of the actions required by the COSHH Regulations were being operated, but the lack of an integrated approach to exposure control was revealed by the deeper questions on the checklist used to compile information before the rating was allocated.

RPE competence assessments

Every quarry site was awarded a rating of 2 for adequacy of RPE, with the sole exception of the open-cast coal site that was maintained in a very clean condition, where RPE was considered not to be necessary as part of an exposure control programme.

The average rating awarded across the eight sites was therefore Rating 2, i.e. ‘RPE used to achieve adequate control. Evidence of provision of suitable and adequate equipment but strong evidence of poor practices in use.’ The principal reason for the grading was the lack of RPE fit testing performed, the outcome of less-than-rigorous consideration of the various factors underpinning an RPE policy.

This does not address the need for the use of RPE when “dry” LEV (which cannot be washed clean) has to be maintained or serviced. In such circumstances RPE is likely to be needed except in cases where a type-H vacuum cleaner can be used to collect dust deposits.

Exposure monitoring:

Of 61 measurements of RCS exposure made for the SBS work, only one indicated 8-hr TWA exposure above the WEL of $0.3 \text{ mg}\cdot\text{m}^{-3}$ that applied at the start of the study. A further 10 measurements (one being composed of two samples) indicated exposure above the 2006 WEL of $0.1 \text{ mg}\cdot\text{m}^{-3}$. Another 12 measurements showed exposure of 0.08 or $0.09 \text{ mg}\cdot\text{m}^{-3}$. The 11 exposures above the tightened WEL represented 18% of all the measurements made and this proportion is somewhat higher than the figure of 14% estimated by employers in response to the questionnaire issued before the RIA was prepared.

Respirable dust exposures were almost all below half the threshold of $4 \text{ mg}\cdot\text{m}^{-3}$ at which respirable dust becomes a substance hazardous to health under COSHH. Only one exceeded $2.0 \text{ mg}\cdot\text{m}^{-3}$, one was above $1.0 \text{ mg}\cdot\text{m}^{-3}$ and one background sample in a control cabin indicated a concentration of $1.0 \text{ mg}\cdot\text{m}^{-3}$. 56 out of 67 samples (84%) indicated exposure at or below $0.5 \text{ mg}\cdot\text{m}^{-3}$, one quarter of the threshold at which respirable dust becomes a substance hazardous to health under COSHH.

It should be noted that both the SBS and the industry questionnaires covered only a small proportion of the industry and therefore could not be considered to give an absolutely robust or statistically valid assessment of conditions: they did however show the present position in a sample of locations.

Most quarries that were part of larger groupings performed exposure monitoring on an annual basis.

5 DISCUSSION

The purpose of the SBS was to establish the current extent of the silica exposure in four sectors of UK industry where the potential risk was either acknowledged or suspected. It was also intended to assess whether the observed level of exposure control was likely to be reliably maintained.

Over the course of the SBS a number of issues were identified which are likely to be contributing to the ongoing incidences of high exposure. A variety of common aspects of exposure emerged in the four sectors, but there were sector-specific observations too. A summary of these is listed below.

5.1 BRICKMAKING

Demand for bricks produced using traditional, dustier, methods remains. During the SBS twice the proportion of exposures were above 0.1 mg.m^{-3} at plants using Hoffman kilns compared with other kilns, despite the numbers of samples at “other” kilns being greatly increased by the inclusion of results from a FOD sampling campaign at one plant (28% of personal samples and 37% of all samples)

Whilst technological advances have allowed a greater degree of automation to be introduced to brick manufacturing facilities replacing older labour intensive methods, there remains a market for various traditionally manufactured brick products e.g. for restoration purposes on historical buildings.

Traditional production facilities continue to require high numbers of workers and are often difficult to introduce engineering controls to. It has to be acknowledged that there is significant difficulty retrofitting new or emerging dust control technology to older brick manufacture process plant. Although a large part of the industry is grouped in large organisations, the capital costs for introduction of engineering controls are potentially prohibitive, particularly at smaller or independent brickmaking facilities. Such sites may still need to rely on RPE to protect workers involved in operations such as brick throwing and the setting and removal of bricks from kilns.

Although some processes have been subject to automation, it does not eliminate the actual generation of dust as bricks are moved mechanically. The risk of exposure therefore remains for process supervisors etc.

Engineering control measures were found to have varying degrees of success in achieving adequate control of exposure. It has been found that across UK industry unsatisfactory performance of engineering controls is often a result of a lack of knowledge or understanding of occupational hygiene principles at the design or installation stages. The LEV seen during the SBS was part of the same picture.

At most of the sites visited for the SBS it was found that where RPE was needed, suitable selection processes, training and face-fit testing had not been conducted. This undermines the potential value and effectiveness of the protection given, and is likely to lead to employees experiencing RCS exposure when relying on respirators that do not fit or are not being worn correctly.

Although technological advances have meant that there is now a greater amount of automation of processes at brickmaking facilities, demand for bricks manufactured using older, labour intensive methods remains. The number of employees involved in the brickmaking sector may

have decreased greatly since the post-war housing boom, however there remain a considerable number of workers involved in the manufacture of bricks using traditional methods (e.g. hand-made, Fletton, etc.) Whilst demand remains for these type of products, e.g. for restoration purposes, then workers will continue to be at risk of exposure to RCS.

With approximately 85% of the UK brick making operations under the management of fewer than six companies the issue of communication with industry is made less problematic. In other more fragmented business sectors HSE has encountered difficulties in effectively communicating information to industry in order to achieve improved standards with regard to health & safety issues. The ease of communication with the UK brickmaking industry has been facilitated by the dialogue with the British Ceramic Confederation.

5.2 CONSTRUCTION

This study does not continue the consideration of the cost of compliance with WELs or of the implementation of controls that formed part of the RIA. However it is acknowledged that the costs of controls do have an effect on the businesses that require them, and the following comments explore the financial context of business size and structure as it affects the implementation of controls.

The majority of (the very large number of) UK construction sector businesses are small or micro businesses: approximately 80% have fewer than five members of staff and 95% have fewer than 20, whether one considers “local units in VAT-based enterprises” or “VAT-based enterprises.” (Where differences exist between the two they reveal something about the organisational structure of the businesses.) Of “VAT-based enterprises,” 14% reportedly have an annual turnover less than £50k, 43% have a turnover below £100k and 71% have an annual turnover below £250K. (Source: 2005 ONS figures shown in Tables 5, 6 and 7 in Appendix A.) They will therefore often hire specialist equipment or plant which may be required for only a short duration during the work, when the costs of outright purchase would not be justifiable. Two other aspects of employment (but which are not quantified here are that among the construction workforce a) there has always been a proportion of relatively lowly-skilled transient workers and b) there is a growing proportion of workers whose mother tongue is not English. These are challenges that are not confined to the construction industry, however.

The improvements to dust control technology made over recent years, particularly as applied to power tools, have given considerable potential for the reduction in worker exposures to RCS across the construction industry. However the extent of the reductions will be greatly dependent on these controls being introduced and effectively utilised. The bimodal distribution of the control competence gradings reflects this. The 3 employers which were graded 4 received this rating as a net outcome of a range of actions that they had taken, but basically reflected the fact that they had formally addressed dust and RCS exposure and installed engineered controls. A single employer received a grading of 3 and a further group who had not engineered out exposure were graded 2.

For various pieces of hire plant or equipment the dust control technology (e.g. water suppression) may be offered as an optional extra. Additionally some pieces of plant or equipment (e.g. drills, routers, angle grinders etc.) can come in two forms, with and without LEV fitted. The equipment without LEV fitted generally has a lower hire cost. It is therefore possible for construction businesses to reduce the costs associated with equipment hire by selecting the cheapest option, i.e. without dust control. In the light of the size and turnover of many employers this represents a very real pressure against using equipment with the best dust

suppression available and probably accentuates the division between employers who recognise the risks of RCS exposure and have policies to minimise it and those who do not.

DIY superstores or construction wholesale suppliers offer RPE that is marketed as being suitable for use with power tools working such materials as concrete (thus probably generating RCS) and hard or softwoods (known carcinogens and sensitisers.) It is usually a respirator of some sort with P2 grade particulate filtration. The assigned protection factor for a P2 grade filter is 10, meaning that, if utilised correctly, the respirator reduces the wearer's exposure to one tenth of what it would have been without it.

A review of the typical dust levels generated for many of the construction activities involving power tools has demonstrated that extremely high concentrations of airborne RCS can be generated in very short periods. A protection factor of 10 might be completely inadequate in many circumstances. Without the presence of dust control measures on portable power tools such as saws and cutting wheels, etc., significant exposures may occur as a consequence of a minor part of a construction worker's various duties in a day.

Some workers in construction may spend much of their working day undertaking a range of tasks which may only be of limited duration, e.g. sweeping dust from a work area, etc. The risk of exposure to RCS amongst these tasks can vary considerably and may not be immediately apparent to the worker, who would probably be relatively lowly-skilled. (In addition if a poorly-trained worker has to do a task for a short duration he may consider it not worth the effort to get his RPE and utilise it for the task.)

The cost pressures on firms are thus compounded by the potentially low appreciation of the risks and consequences of RCS exposure among a workforce which is difficult to communicate with effectively. This is of concern because where PPE (Respirators) are relied upon to control exposure, the effectiveness of the measures depends heavily on the personal discipline of the wearer, which is itself a function of training, understanding and motivation. These are all factors difficult to maintain in a casual workforce with language problems.

There is therefore a value in removing responsibility for exposure control from the worker and from the site manager as far as possible. If power tools were only available in models which incorporate dust suppression or collection and a further feature is that the power to the machine is interlocked with the dust suppression feature it is more likely that control will be achieved. This applies particularly to items of equipment such as Stihl saws or abrasive cutting wheels. The benefits showed in tunnelling, where the drilling machines used to prepare for blasting incorporated water dust suppression and respirable particulate did not exceed 0.3 mg.m^{-3} during the work.

Research in the US (Rappaport et al, 2003) indicates that industry perception of the scale of exposures to RCS across construction activities is hugely optimistic. Industry responses to the HSE RIA questionnaire estimated that about 9% of construction workers were exposed to RCS levels above 0.05 mg.m^{-3} . The Rappaport study estimated that the probability of RCS exposure levels above 0.05 mg.m^{-3} to be between 64.5 – 100% within the US construction industry. The SBS assessments of control competence (50% graded "2") suggest that effective ongoing control of RCS exposure is unlikely in the UK too.

Activities

In kerb and slab cutting, water fed to cutting wheels effectively suppresses dust release (although re-suspension of RCS from dried deposits is still possible.) Tools are available without dust suppression and "water-fitted" tools are useable without water, which both undermine the likelihood that this dust control will be applied. There is an awareness of the

high-value of saw blades and these are more likely to be protected from damage by the correct use with cooling water supplied. (This is the opposite of the position with abrasive cutting wheels, which because they have a “sacrificial” cutting edge are generally considered to be disposable.) Anecdotal evidence and personal experience show that the cutting of stone and concrete without dust suppression continues, although the gangs from the two employers seen for the SBS (a local authority DLO and a major contractor) did supply dust-suppressed tools. This is probably an almost inevitable consequence of assessing exposure by appointment: organisations sufficiently large to be identifiable and able or prepared to offer to allow assessment and monitoring of exposure are likely to have in place a RCS exposure reduction strategy.

During the grit-blasting of buildings two sites were seen where water suppression was not used for different reasons. At one location a summer water shortage was taken as an adequate reason not to use wet blasting. In fact it is doubtful that the hosepipe ban (as then worded) would have covered the activity, and the readiness to work without water indicates the low priority given to the minimisation of RCS dispersion by the dutyholder. The other blast cleaning operator claimed to need to work without water to avoid slurry accumulating in pockets of the carved stonework. The consequence here was 8-hour TWA RCS exposure of 0.72 mg.m^{-3} . Again, this reveals the low priority given to preventing dust release, when one might expect wet dust suppression plus an additional final clean after the blasting had finished to have been a viable option.

Where mortar removal prior to repointing was seen, the financial/commercial structure might have had an effect. It was considered that the franchise structure focussed more on marketing and technical delivery, with less emphasis on support for COSHH assessments and other safety systems. Although efforts were being made to optimise the dust extraction on the cutting tools, the risk assessments for the work were not seen as a significant part of site procedures. (One tool manufacturer has now developed a reciprocating saw specifically for mortar removal, which is claimed to dramatically reduce the dust generated when compared with the use of cutting wheels. The tool is not cheap, but is reported to justify the purchase price rapidly by the increased speed of work and reduced site cleaning costs.)

At concrete recycling plants water spray dust suppression was used on crushing machinery, but it was acknowledged that it was better to eliminate the need for an attendant to work at a dusty location. This could be achieved by ensuring suitable feedstock, i.e. by rigorously separating out materials that would have needed to be retrieved from the crusher at a dusty stage of the process.

During tunnelling water dust-suppression on drills was seen to be effective. Respirable dust and RCS exposures were considered unlikely to approach WELs, including the reduced 2006 figure for RCS. Shotcreting could be required over a period sufficiently long that the WEL for respirable particulate would be exceeded and RCS exposure might also exceed the (new) WEL. Ventilation of the worksite by the standard tunnelling arrangement (whereby clean air is supplied at the working face) has the disadvantage that it disperses aerosols generated during shotcreting or other contaminants to the rest of tunnel. This breaches the basic occupational hygiene principle of negative pressure extraction.

5.3 STONEMASONRY

Stonemasonry – Exposure Control Measures

Engineering controls are used in some stonemasonry workshops, but there is still a high reliance on RPE to control high exposures, even when power tools (which generate dust concentrations beyond the protection afforded by RPE) are used. Although power chiselling has the potential to produce high respirable crystalline silica exposures, HSE's Respirable Crystalline Silica Exposure Assessment Document (HSE, 1998) suggested that very few operators used engineering controls, relying only on RPE.

A series of HSE visits to stonemasonry companies in 2002/2003 revealed several sites where inexpensive improvements could be made. A site visit in 2003 to a company using marble, granite and limestone to produce bathroom and kitchen worktops showed that though some equipment was wet-fed, masons used angle grinders and edge polishers without water suppression. Extraction was by flexible ducts above the workstation. Although booths are recommended (HSG 201), the use of type-H vacuum cleaners to remove dust daily, or at least the damping down of dust will reduce RCS exposure by themselves.

Another similar site visited earlier (in 2002), where granite was the main stone being used, revealed that RCS exposures ranged between 0.15 and 0.4 mg.m⁻³ (8-hour TWA.) Changes such as the refurbishment of extract ducts and the installation of down-draught extraction for work with hand tools, plus increased use of wet cutters and polishers reduced all RCS exposure to below 0.15 mg.m⁻³ (8-hour TWAs).

Visits by HSE (in 2002 and 2003) to a marble and limestone fireplace manufacturer showed all RCS exposures were below 0.07 mg.m⁻³, probably more a consequence of the low silica content of the material than the efficiency of the controls - although the automated wet-cutting machines controlled dust emissions effectively. In the dry process area, the use of segregation and improved engineering controls made significant differences – a reassuring confirmation of HSE guidance suggesting that large-scale use of rotary tools should take place in a separate area.

The results of the telephone-administered questionnaire responses received from the sites visited during this study indicate that despite the production of detailed, practical guidance and publication of the plan to significantly reduce the current pre-2006 WEL there was very little awareness of either the guidance available or of the impending reduction of the hygiene standard. Only 2 companies were aware of INDG315 and barely half knew of HS(G)201. Out of 13 active employers, only 4 could identify silicosis as a disease of stoneworkers and only one identified lung cancer as a health risk.

Communication between HSE and SME's has long been recognised as a difficult area (and not limited to the stonemasonry sector.) Research has shown that HSE's 'Good Health is Good Business' campaign, one of HSE's largest recent campaigns, was found to have reached only 28% of small companies compared to 73% of larger organisations (Honey et al. 1997).

Another study (Rakel et al. 1999) found that non-compliances were present across industrial sectors and in relation to specific health hazards even when levels of knowledge and awareness were adequate. This was supported by the results of the Silica Baseline Survey. Even at those sites where there was a demonstrable knowledge of current legislation and the health risks associated with exposure to RCS, non-compliances were commonplace.

It is acknowledged that in many SME's, Environment, Health and Safety matters are generally one of a range of priorities competing for management attention and resources. This means that not only is HSE faced with the challenge of raising awareness and knowledge of legislation and guidance in the stonemasonry sector but it may be necessary to compliment this with interventions or enforcements designed to provide opportunities for direct communication with industry to assist delivery and implementation.

Even in traditional stonemasonry, many stonemasons are still highly exposed to RCS and it is possible that exposures have got worse since the 1980s and the potential incidence of silicosis (and other risks) might therefore have increased. Given the relatively small numbers of stonemasons, the fact that they show up in the SWORD figures is unusual and therefore the prevalence is disturbing. It is possible that they are still the highest at-risk group. This could be the consequence of a number of factors.

- Many stonemasons are craftsmen or women (more women are now coming into the trade) and having learnt the trade it is a career they stay in. They therefore work with stone most of their professional life, rather than spending only a few years in the industry as is common in sectors such as construction.
- In the 1980s electrically powered disc cutters and polishers were introduced, and these are capable of causing very high exposures. HSG 201 (HSE 2001) shows that exposures of 5 to 10 mg.m⁻³ RCS were typical and 50 or even 100 mg.m⁻³ was possible.
- In recent years many kitchen companies have promoted worktops and sinks made of granite, other stone types and silica-containing composites, causing a significant extension of stonemasonry.
- It is also possible that masons and their employers do not appreciate how high exposure can be. The lack of formal planning of exposure control (i.e. COSHH Assessments) together with the small size and turnover of the typical company in the sector also leads to a very low priority being given to exposure measurement of any kind.

The results from the field investigations undertaken for the SBS indicated that 42% of RCS exposures in stonemasonry were above 0.1 mg.m⁻³. This demonstrates that there appears to have been very little overall reduction in RCS exposures since the HSE visits between 1992 and 1995.

This failure by the stonemasonry industry to make significant improvements in control of exposures to RCS since 1995, despite the publication of various HSE practical guidance documents aimed at this sector (HSG 201 & INDG315), indicates that the enforcement of the new WEL would be likely to have a major impact on the industry.

Stonemasonry: Industry profile

This investigation has shown that the majority of stonemason businesses continue to fall into the category of small to medium enterprises (SME's). ONS data from 2005 reveals that approximately 1200 businesses in the UK have the Standard Industrial Classification (SIC) code 26.70 - Cutting, shaping and finishing of ornamental and building stone. This data, the distribution of company sizes and extrapolated employment numbers are shown in table 8 in Appendix A.

The data reveals that almost 85% of stonemasonry businesses have workforces of fewer than 10 persons and could therefore be classified as small or micro businesses. Less than 6% of stonemasonry businesses have more than 20 employees and all have fewer than 100. The

average size of a UK stonemasonry business is estimated to be 6 employees. It should be noted however that SIC code 26.70 *excludes* activities carried out by operators of quarries, e.g. production of rough-cut stone, so the numbers discussed in this report might be under-estimates.

5.4 QUARRY INDUSTRY

The prevailing economic climate applies pressures which cause a variety of outcomes. There has been considerable consolidation of the sector and (on exposure outcomes) this might be seen as having a net beneficial effect. The fact that previously small businesses are part of larger groupings leads to both the strategic investment of larger funds but also the pressure for higher productivity. These two together lead to the purchase of bigger and more expensive items of plant with the secondary effect that these items are more likely to be supplied with enclosed cabs and other H&S features (such as vibration & noise reduction and ergonomic cabs) besides air-conditioning supplied with filtered air as original fittings.

The price of such large items of plant also means that they are more likely to be purchased with some kind of warranty, and that maintenance to ensure the effective functioning of such valuable assets is a significant management priority. Warranties tend to reinforce maintenance as the manufacturer specifies schedules and the contracts are invalidated if they are neglected.

A second significant benefit of consolidation is the availability of broader and deeper H&S expertise [i.e. more and better-qualified people] within larger business groups. When a large organisation has a fully-qualified Safety Officer working to ensure compliance through the organisation and reporting to the board of directors, pressure to adopt good practice is likely to be applied and the necessary funds are more likely to be made available. This is not the case with trade associations which, although they will typically brief members on legislative requirements, have not traditionally operated any compliance or enforcement regime.

The Quarry Products Association (QPA) is the UK rapporteur for the aggregate industry under the SDA. In addition to the COSHH obligation to implement the principles of good control practice and to prevent RCS exposures exceeding the current WEL, UK QPA members are required to operate a regime for checking compliance against the SDA Good Practice Guide. This is part of the recording and reporting arrangements forming part of the Agreement, in addition to other safety performance indicators reported to the trade association. The SDA guide reflects COSHH Essentials, but is somewhat broader. The QPA has a total membership of about 150 of whom about 80 members operate quarries in Great Britain, employing approximately 14.5 thousand workers. Employers who are members of other trade associations or of none remain subject only to HSE regulatory arrangements.

Issues

The potential liabilities arising from the neglect of exposure controls are significant, but are not necessarily an issue always perceived as demanding immediate management attention. In these circumstances, particularly if pressure is being applied for higher output per person, RCS exposure control (the net outcome of numerous smaller actions) can slip as other more immediate demands are addressed. The changes of management structure that accompany re-organisations when companies assimilate new acquisitions can add to the factors which distract dutyholders from attention to the detail that keeps plant maintained and RCS exposure controls functioning effectively. QPA members implementing the SDA are subject to a level of internal performance reporting which might help address this risk; however smaller independent operators which are not members of a trade body remain subject only to UK legislation and HSE oversight.

In the circumstances and where a formal assessment of RCS exposure (and exposure prevention) has not been made, ongoing effectiveness is perhaps even less likely to be maintained. Small organisations still exist without safety expertise: for consistency the 2005 ONS figures are discussed throughout the SBS work, but it is significant that the 2006 figures show 7% fewer “local units” in quarrying (335 instead of 360.)

In some cases even where significant resources and effort have been applied to the installation of engineered exposure controls the work has not been followed through to the point where all unacceptable exposures have been identified or controlled.

5.5 SBS ASSESSMENT PROCESS

The methodology used for the SBS assessments of Control Competence provided a structured way to judge whether dust and RCS exposures were likely to be or remain within the exposure limits.

It is possible that the ratings that were allocated in the survey were not entirely consistent across all the sites and some may have been more generous than others. In particular some ratings of 4 (“achieved COSHH Essentials standard”) were not compatible with the measured exposures above the 2006 WEL for RCS. 9 employers were rated 4 for control competence and of these the silica exposures were above 0.1 mg.m^{-3} at 5 locations, although none exceeded 0.3 mg.m^{-3} , the previous WEL.

After assessing the RPE Competency it has been realised that there is a gap between NR and 1. Where a plant operates fully adequate engineered exposure controls, NR (“RPE not required to achieve adequate control”) would seem to apply. This may be the case for most of the time, but maintenance of the controls will almost invariably require the use of RPE. It is conceivable that engineered controls could be decontaminated by vacuum cleaner or wet methods before repairs started, but considered unlikely in most circumstances. In these circumstances there is no suitable single RPE Competency rating that sums up the situation. Further work using this rating method might use supplementary ratings such as “NR* (*1 for maintenance activities.)”

6 CONCLUSIONS

Over the course of the SBS a number of issues were identified which are likely to be contributing to the continuing incidences of high exposures. A summary of these is listed below

6.1.1 Brickmaking conclusions

SBS results suggest that previous recent HSE & industry estimates of silica exposures may be lower than actual exposures.

Demand for bricks produced using traditional, dustier, methods remains and traditional production facilities continue to require high numbers of workers. In these plants it would be difficult to retro-fit engineering controls.

Automation of various processes has been unable to eliminate generation of dust as bricks are moved, so risk of exposure remains for machine operators etc.

Engineering control measures were often found to have varying degrees of success in achieving adequate control of exposure.

Unsatisfactory control is often a result of a lack of knowledge or understanding of occupational hygiene principles at the design & installation stage of engineering controls, rather than failure through neglect.

The capital costs of the introduction of engineering controls are recognised as potentially prohibitive, particularly at smaller independent brickmaking facilities. (This is partly due to the difficulty of retrofitting emerging dust control technology to older brick manufacture process plant.)

Suitable selection processes, training and face-fit testing were often not conducted in regard to RPE.

The implementation of the SDA might put additional pressure (on those employers who are members of NEPSI-affiliated associations) to reduce exposures at least to the UK WEL of 0.1 mg.m^{-3} .

6.1.2 Construction conclusions:

Many activities in construction are capable of generating dust and RCS concentrations considerably above WELs. This may have been worsened as a consequence of the wider availability of power tools.

Employers have underestimated the extent of exposures, and in many cases have not made the implementation of exposure control a priority (revealed when assessed by “control competence”).

Adoption of engineered controls as standard would in most cases reduce exposures to within WELs. Conversely, where controls are not applied (e.g. dry grit-blasting buildings or cutting out mortar without effective on-tool extraction) exposures are likely to continue to exceed WELs.

RPE competency is not adequate to ensure reliable protection when engineered controls are not applied.

Where high-value plant has been introduced (e.g. rock-drilling machines in tunnelling, crushers at recycling plants) dust suppression measures are more likely to have been installed than where small items of plant are in use.

6.1.3 Stonemasonry conclusions:

Over the course of the SBS a number of significant issues were identified which are likely to be contributing to the incidences of high exposure occurring in the stonemasonry sector. A summary of these is listed below:

SBS results suggest that earlier industry estimates of silica exposures are considerably lower than actual exposures (0 % compared to the SBS figures of 19% above 0.3 mg.m^{-3} and 41% above the new WEL of 0.1 mg.m^{-3} RCS.)

Even HSE estimates of exposures above the proposed WEL (0.1 mg.m^{-3}) were less than half of the proportion actually found. Both the underestimates would contribute to a lower level of attention to exposure reduction than is required

This is compounded by a poor level of awareness within the sector regarding the health risks posed by exposure to RCS, particularly amongst workers. There is also a poor level of understanding of the silica content of different stone types.

Responsibility for health & safety is often an additional duty of a production manager or similar (if such a formal designation exists – 85% of locations employ fewer than 10 workers and 94% employ fewer than 20 workers.) The industry pattern of dispersed employment and small units is recognised as presenting communication challenges.

There is a lack of formal knowledge, extending to a poor understanding of legislative requirements, particularly COSHH, and the requirements for LEV testing, face fit testing, health surveillance etc. Engineering controls that have been applied, e.g. LEV systems, are very often ill-conceived and not fit for purpose, reflecting the level of expertise in the supply industry. These failures are then unlikely to be recognised because of the low level of expertise available in-house in the stonemasonry industry and the general habit of not having exposures monitored (when external consultants might highlight the control failures.)

On-tool dust suppression or extraction has by no means been universally adopted and could be much more widely used. However introduction will need to be carefully planned to ensure user-acceptance and adequate maintenance to ensure ongoing use and effectiveness.

While reliance is being placed on RPE the exposure risk remains as long as selection, training and face-fit testing are not conducted.

It is possible that an increase in non-English-speaking EU workers in the sector will bring the problems associated with a transient workforce, such as increased training needs compounded by language problems.

6.1.4 Quarry sector conclusions:

Lack of formal assessment of silica exposure and the control measures needed is not uncommon.

Approximately 40% of measurements showed exposure to RCS either above or within 20% of the 2006 WEL of 0.1 mg.m^{-3} (i.e. $\geq 0.08 \text{ mg.m}^{-3}$.)

Large modern items of mobile and static plant tend to have control measures supplied as standard, but ongoing effectiveness of exposure controls depends on effective maintenance.

In addition to the big groupings small-scale employers exist who may not have arranged access to professional health and safety advice. Large quarry groupings are well-equipped in terms of health and safety expertise, but (lack of) actions by local management and supervision can undermine exposure control regimes (e.g. lack of attention to detail in maintenance of systems.)

Annual exposure monitoring is common among the larger employers but by no means universal, in common with health surveillance.

Where RPE needs to be used more robust policies are needed to ensure that fit testing is performed and that staff training is adequate to ensure appropriate use.

7 APPENDICES

7.1 APPENDIX A: TABLES

Table 1: Summary of SBS data: Brickmaking sector

Table 2: Summary table of SBS data: Construction sector

Table 3: Summary table of SBS data: Stonemasonry sector

Table 4: Summary table of SBS data: Quarry sector

Table 5: Data from ONS summary of employment statistics, 2005 – local units by employment size band (from table A2.1)

Table 6: Data from ONS summary of employment statistics, 2005 – “VAT-based enterprises” by employment size band (from table B4.1)

Table 7: Data from ONS summary of employment statistics, 2005 – VAT-based enterprises by turnover size band (from table B5.1)

Table 8: 2005 ONS Statistics for SIC 2670, Number of local units and VAT-based enterprises etc. in stonemasonry

Table 9: Responses to SBS telephone follow-up questionnaire.

Table 1: Summary of SBS data: Brickmaking sector

Site	Activities	Control strategy	Samples collected		Number of measurements (8-hr TWAs)					Competency Descriptor Ratings		Material type
					RCS			Respirable Dust		Control	RPE	
			Personal	Static	≥ 0.3 mg.m ⁻³	$0.3 > x \geq 0.1$ mg.m ⁻³	Highest exposure mg.m ⁻³	Exposure above 4 mg.m ⁻³	Highest exposure mg.m ⁻³			
B1	A	W	5	3	0	0	0.099			4	2	
B2	A	LEV, RPE	9	2	0	5	0.23	0	2.2	4	2	Argillaceous rocks: clay, shale and slate
B3	A	LEV	5	2	0	2	0.198	0	1.236	4	2	Coal measure shale, clay
B4	D	LEV	7	3	0	3	0.214	0	1.37	4	3	
B5	B	N/A	9	2	0	0	0.092	0	0.845	3	N/A	
B6	E		7	2	0	5	0.24	0	3.31	3	2	Clay, Hoffman kilns
B7	F & A	LEV & W	11	1	1	3	0.357	0	1.12	3	3	“clay”
B8	C	N/A	7	0	0	0	0.092	1	4.97	3	3	Sand, silica sand
B9	B		10	4	0	0	0.09	0	0.75	3	2	
B10		W										Visit postponed indefinitely
B11	A		27	25	4	5	0.79	3	11.06	N/A	N/A	Clay, shale
Totals:			97	45	5	23		4				
Percentages:					5%	24%		4%				

Activity: A: Extruded clay brick production, B: Hand made bricks, C: Concrete bricks, D: Clay & terracotta products, E: Fletton process / London bricks, F: Soft clay brick production

Control strategy: Silica Essentials Control approaches: W = Water suppression, LEV = Local exhaust ventilation

Table 2: Summary table of SBS data: Construction sector

Site	Activities	Control strategy	Samples collected		Number of measurements (8-hr TWAs)					Competency Descriptor Ratings		Material type
					RCS			Respirable Dust		Control	RPE	
			Personal	Static	≥ 0.3 mg.m ⁻³	$0.3 > x \geq 0.1$ mg.m ⁻³	Highest exposure mg.m ⁻³	Exposure above 4 mg.m ⁻³	Highest exposure mg.m ⁻³			
C1	B	RPE, W	4	1	0	0	0.05	0	1.19	4	2	Aggregate, concrete slabs
C2	B	RPE	6	2	0	0	0.021	0	0.296	3	N/A	Granite slabs, Concrete Kerbs
C3	D	RPE	2	2	1	0	0.717	1	44.08	2	2	Non-silica abrasive, sandstone
C4	D	PPE	2	0	0	0	0.069	1	8.09	2	2	Facing bricks, pavements, non-silica abrasive
C5	C	RPE, LEV	3	0	0	1	0.14	1	2.79	2	2	Sand and cement mortar
C6	C	RPE, LEV	1	0	0	1	0.22	1	2.25	2	2	Sand and cement mortar
C7	A	W, RPE	2	0	0	1	0.118	0	0.35	4	2	Recycling concrete
C8	A		4	0	0	0	0.03	0	0.314	4	N/A	
C9a	E	W	2	1	0	0	<0.01	0	0.2			Drilling medium- silica schist
C9b	E		3				0.07	0	1.5			Shotcreting
Totals:			29	6	1	3		4				
Percentages:					3%	10%		14%				

Activity: A: Movement, crushing, screening of rubble and aggregates B: Highway & pavement maintenance (kerb / paving stone cutting) C: Repointing - Removal of brickwork mortar using power tools. D: Abrasive blasting - High pressure cleaning of surfaces (buildings) using (non-silica) abrasives. E: Tunnel construction - Drilling and shotcreting.

Control strategy: Silica Essentials Control approaches: W = Water suppression, LEV = Local exhaust ventilation, LEV = Local exhaust ventilation

Table 3: **Summary table of SBS data: Stonemasonry sector**

Site	Activities	Control strategy	Samples collected		Number of measurements (all 8-hr TWAs)					Competency Descriptor Ratings		Material type or comment
					RCS			Respirable Dust		Control	RPE	
			Personal	Static	≥ 0.3 mg.m ⁻³	$0.3 > x \geq 0.1$ mg.m ⁻³	Highest exposure mg.m ⁻³	Exposure above 4 mg.m ⁻³	Highest exposure mg.m ⁻³			
S1A	C	RPE & LEV	4	3	4	0	7.8	4	34	0	2	SS & LS
S1B	C	RPE & LEV	2	1	0		<LOD	2	23.8	1	2	LS
S2	A & C	LEV	5	0	0	0	0.08	0	2.32	1	N/R	
S3	A, B, C & D	RPE & LEV	7	0	0	3	0.16	0	2	2	2	
S4	A, B, C & D	RPE & LEV	6	0	0	1	0.12	0	0.97	1	2	
S5	A & C	RPE & LEV	4	0	0	0	0.07	0	2.14	1	2	Granite
S6a	A, B & C	RPE	6	0	1	0	0.90	2	6.41			Mostly limestone, 1 granite
S6b	A, B & C	LEV	3	0	0	1	0.215	0	1.87			N/A
S7	A & C	RPE & LEV	6	2	0	2	0.25	N/a	N/a	4	4	Granite
S8a	A & C	W	7	0	0	5	0.18	0	0.53	3	2	
S8b	A, B, C & D	LEV & RPE	7	1	5	1	1.91	2	32.54	N/A	N/A	
S9	A & C	RPE, LEV & W	3	4	0	0	<LOD	1	11.54	2	2	Zero-silica stone suspected.

Site	Activities	Control strategy	Samples collected		Number of measurements (all 8-hr TWAs)					Competency Descriptor Ratings		Material type or comment
					RCS			Respirable Dust				
			Personal	Static	≥ 0.3 mg.m^{-3}	$0.3 > x \geq 0.1$ mg.m^{-3}	Highest exposure mg.m^{-3}	Exposure above 4 mg.m^{-3}	Highest exposure mg.m^{-3}	Control	RPE	
S10	A, C & D	RPE, LEV & W	5	0	0	0	0.065	0	0.64	3	N/R	Sandstone
S11	A, B, C & D	RPE & W	8	0	1	2	16.25	2	43.5			
S12	A & C	LEV & W	3	2	1	1	1.01	0	2.61	1	2	Sandstone
S13	A, C & D	LEV	4	4	1	0	0.85	1	16.73	3	2	Sandstone
S14a		LEV & RPE	6	1	2	4	0.4	5	10.9			Granite
S14b		LEV & RPE	3	1	2	0	0.69	1	9.77			
S14c		W, LEV & RPE	5	3	0	2	0.15	0	1.73	3	2	Post improvements
Totals:			94	22	17	22		20				
Percentages:					18%	23%		21%				

Activity: A: Primary / secondary sawing B: Boring, polishing (static) C: Cutting / polishing (hand-held). D: Chiselling (manual / pneumatic).

Control strategy: Silica Essentials Control approaches: W = Water suppression, LEV = Local exhaust ventilation, LAD= Local Air Displacement

Table 4: Summary table of SBS data: Quarry sector

Site	Activities	Control strategy	Samples collected		Number of measurements (8-hr TWAs)					Competency Descriptor Ratings		Material type
					RCS			Respirable Dust		Control	RPE	
			Personal	Static	≥ 0.3 mg.m ⁻³	$0.3 > x \geq 0.1$ mg.m ⁻³	Peak exposure mg.m ⁻³	Exposure above 4 mg.m ⁻³	Peak exposure mg.m ⁻³			
Q1	A, C & D		8	1	0	0	0.03	0	0.71	3	2	Quartz-veined Dolerite
Q2	A, B & D		15	2	0	2	0.18	0	0.76	2	2	sandstone
Q3	A	W	13	0	0	0	0.05	0	0.51	4	N/R	Sandstone, coal
Q4	A		3	1	0	1	0.19	0	0.41	1	2	Sandstone
Q5	A, B & D		7	0	0	1	0.16	0	0.59	2	2	N Wales slate
Q6	A & E	LEV	4	2	1	3	0.79	0	2.52	3	2	N Wales slate
Q7A & B	D	W,	6	2	0	2	0.15	0	1.39	3	2	Silica sand
Q8	A, B,	W, LEV	3	1	0	0	0.06	0	0.22	2	2	Greywacke
Totals:			61	9	1	9		0				
Percentages:					2%	14%						
“Average:”										2.5	2.0	

Activities: A Extraction of stone, B Primary crushing at face C: Primary crushing remote, D Secondary crushing and screening, E Sawing & splitting slate.

Control strategy: Silica Essentials Control approaches: E: (2) Engineering control, C (3) Containment, R: RPE.

Table 5: Data from ONS summary of employment statistics, 2005 – local units by employment size band (from table A2.1)

Activity: Division 45, Construction:	Employment size band:								
	0 - 4	5 - 9	10 - 19	20 - 49	50 - 99	100 - 249	250 -499	500+	Total
Number of local units	155,620	21,330	10,830	6,655	1,995	1,095	375	85	197,855
percentage	78.7%	10.8%	5.5%	3.4%	1.0%	0.6%	0.2%	0.0%	
Cumulative percentage	78.7%	89.4%	94.9%	98.3%	99.3%	99.8%	100.0%	100.1%	
Notional size	2	7	15	35	75	175	325	510	
Derived Employment numbers:	311,240	149,310	162,450	232,925	149,625	191,625	121,875	43,350	1,362,400

Table 6: Data from ONS summary of employment statistics, 2005 – “VAT-based enterprises” by employment size band (from table B4.1)

Activity: Division 45, Construction:	Employment size band:									
	0 - 4	5 - 9	10 - 19	20 - 49	50 - 99	100 - 249	250 -499	500 -999	1000+	Total
Number of local units	152,715	19,900	9,445	5,280	1,165	605	165	75	70	189420
percentage	80.6%	10.5%	5.0%	2.8%	0.6%	0.3%	0.1%	0.0%	0.0%	
Cumulative percentage	80.6%	91.1%	96.1%	98.9%	99.5%	99.8%	99.9%	100.0%	100.0%	
Notional size	2	7	15	35	75	175	325	750	1010	
Derived Employment numbers:	305,430	139,300	141,675	184,800	87,375	105,875	53,625	56,250	70,700	1,074,330

Table 7: Data from ONS summary of employment statistics, 2005 – VAT-based enterprises by turnover size band (from table B5.1)

Activity	Turnover size (£ thousand):										
	0-49	50-99	100-249	250-499	500-999	1,000-1,999	2,000-4,999	5,000-9,999	10,000-49,999	50,000+	Total
Division 45, Construction	27,485	54,990	52,490	23,375	15,000	8,245	5,135	1,575	1,150	245	189,695
percentage	14.5	29.0	27.7	12.3	7.9	4.3	2.7	0.8	0.6	0.1	
Cumulative percentage	14.5	43.5	71.1	83.5	91.4	95.7	98.4	99.3	99.9	100	

Table 8: 2005 ONS Statistics for SIC 2670, Number of local units and VAT-based enterprises etc. in stonemasonry

Activity: 26.70 - Cutting, shaping and finishing of ornamental and building stone	Employment size band:							Total
	0 - 4	5 - 9	10 - 19	20 - 49	50 - 99	100 - 249	250+	
Notional size	2	7	15	35	75	175	250	
Number of local units in Vat-based enterprises:	785	225	115	55	15	0	0	1200
Cumulative %	66%	85%	94%	99%	100%			
Employment numbers:	1570	1575	1725	1925	1125	0	0	7920
Number of VAT-based enterprises	645	200	105	60	15	0	0	1025
Cumulative %	63%	82%	93%	99%	100%			
Employment numbers:	1290	1400	1575	2100	1125	0	0	7490

Table 9: Responses to SBS telephone follow-up questionnaire.

<u>Company</u>	Questions: Stone worked:	WEL:		Control	Know/have guidance?				Know diseases?			Want info via:	
		Aware of redn?	Know new?	Improvemts planned?	HS(G) 201	INDG 315	COSHH	COSHH & Silica essentials	Silicosis	Lung cancer	Copd / emphysema	Internet ?	post?
1	sandstone	Y	Y	N	N	N	Y	Y	Y			Y	Y
2	granite	N			Y	N	Y	N	"LUNGS"			Y	Y
3	sst, gritstone	Y	N	Poss	Y	N	Y	N	Y		Y	Y	Y
4	Marble, granite	N			N	N	N	N	-	-	-	Y	Y
5	Sst	N			Y	N	Y	Y			Y	Y	Y
6	Limestone	N			Y	N	Y	Y			Y	Y	Y
7	Granite	Y	N	Y	N	N	Y	N	-	-	-	Y	Y
8	Gran, Marble, Sst, concrete	Y	N	Y	Y	N	Y	Y		Y		Y	Y
9	Sandstone	N			Y	Y	Y	Y	"Lungs"			Y	Y
10	Granite	N			N	N	N	N	"Lungs"			Y	Y
11	80% sst 20% Lst	N			N	Y	Y	N	Y		Y	Y	Y
12 - no production now	(marble, lst)	N											
13	granite 30% marble 70%	N			N	N	Y	Y			Y	Y	Y
14	Granite, marble	N			N	N	N	N	Y			Y	Y
Totals:	Y	4	1	2	6	2	10	6	4	1	5	13	13
	N:	10	3	1	7	11	3	7				0	0
				1 POSS									

APPENDIX B COMPETENCY SURVEY TABLES

Control competency descriptors

Control Rating	Description
0	Evidence of unacceptable levels of over-exposure brought about through manifest failures to recognise hazard and risk coupled with a failure to provide any form of controls. (As a guide exposures at least twice relevant occupational exposure limit)
1	<p>Evidence of unacceptable levels of over-exposure brought about through failures to recognise hazard and risk and take appropriate steps to control. Typically:</p> <ul style="list-style-type: none"> • Absent or inadequate COSHH assessment • Evidence of rudimentary or inappropriate engineering controls • Controls appropriate only for lower level of risk • No supporting evidence of adequate control • No records of examination and test of lev • Poor maintenance of plant, enclosures and controls • Poor training of operators • No awareness of hazard, levels of exposure or risk <p>(a) Poor management</p>
2	<p>Evidence of over-exposure. Some understanding of hazard and risk and some controls in place but not receptive to need to improve. Typically:</p> <ul style="list-style-type: none"> • Inadequate COSHH assessment • Engineering controls poorly maintained and/or poorly positioned • Uncertain of adequacy of control • Limited understanding of exposures • Limited training of operators • Some use of RPE • Poorly informed management and supervision
3	<p>Occasional over-exposure. Reasonable awareness of hazard and risk and desire to improve. Typically:</p> <ul style="list-style-type: none"> • Reasonable COSHH assessment recognising main concerns • Application of reasonably effective controls at process • Reasonable levels of maintenance • Some understanding of exposures but few over-exposures • Limited training of operators • Some use of RPE • Reasonably informed management • Some supervision

Control Rating	Description
<p>4</p> <p>The COSHH Essentials Standard</p>	<p>Adoption of good control practice consistent with risk. Reasonable awareness of hazard and risk and knowledge to implement effective strategies. Typically:</p> <ul style="list-style-type: none"> • Comprehensive COSHH assessment • Aware of literature and information sources • Application of appropriate, effective, well maintained controls at process • Management and operator understanding of exposures • Well trained operators • Designated areas and use of RPE when appropriate • Well informed management • Competent supervision <p>Evidence of coordinated approach to control – skills and knowledge available</p>
<p>5</p>	<p>Exemplary control consistent with risk. Typically:</p> <ul style="list-style-type: none"> • Comprehensive COSHH assessment • Literature and guidance to hand • Competent well-trained staff at all levels • Documented procedures • Exposure and risk understood at process • No evidence of over-exposure • Evidence of engagement of all stakeholders • All aspects of process considered

RPE competency descriptors

Rating	Description
NR	RPE not required to achieve adequate control
1	RPE required to achieve adequate control. No evidence of use or provision of suitable and adequate RPE
2	<p>RPE used to achieve adequate control. Evidence of provision of suitable and adequate equipment but strong evidence of poor practices in use:</p> <ul style="list-style-type: none"> • Limited evidence of selection process and face fit testing. • Equipment normally available but anticipated problems with use • Poor storage • No evidence of adequate training programme • No assessment of level of residual risk
3	<p>RPE used to achieve adequate control. Evidence of provision of suitable and adequate equipment and some evidence of good practices. Limited evidence of management controls in use:</p> <ul style="list-style-type: none"> • Face fit testing • Equipment readily available and used • Appropriate storage facilities • Adequate initial training • Operator can answer questions about use of RPE • Some understanding of role of rpe in reducing residual risk
4	<p>RPE used to achieve adequate control. Verifiable policy on RPE linked to COSHH assessment. Strong evidence of selection of suitable and adequate equipment and good practices in use. Appropriate zoning of workplace and adequate supervision and control. Some minor concerns over procedural aspects and management control of programme:</p> <ul style="list-style-type: none"> • Verifiable policy on RPE linked to COSHH assessment. • Face fit testing programme • Equipment routinely available and range of products available through selection process • Appropriate storage facilities • Initial training and refresher training • Operator understands role of RPE in controlling exposure • Clearly defined roles and responsibilities
5	<p>RPE used to achieve adequate control. Evidence of exemplary RPE programme with only minor deviations from agreed practices and policies.</p> <ul style="list-style-type: none"> • Verifiable policy on RPE linked to COSHH assessment. • Face fit testing programme • Wide range of appropriate equipment available for all users • Appropriate storage facilities and procedures to allow audit • Initial training and routine refresher training • Operators understand role of RPE in controlling risk • Everyone understands roles and responsibilities

APPENDIX C: STANDARD INDUSTRIAL CLASSIFICATION SUBDIVISIONS

The breadth of the industries are illustrated by the descriptions used in the UK Standard Industrial Classification, the key to one of the Office of National Statistics' (ONS) analyses of UK employment.

At the time of this SBS work the classifications in use were those in the "UK Standard Industrial Classification of Economic Activities 2003 – SIC (2003)" (Ref g), although it should be noted that the 2007 classification will supersede the 2003 version in January 2008.

The descriptions of the divisions are reproduced below; some are relatively restricted and only included here for consistency, whereas others such as construction effectively illustrate the range of activity included.

In Section D, Manufacturing, Subsection DI, Division 26 Manufacture Of Other Non-metallic Mineral Products contains:

26.40 Manufacture of bricks, tiles and construction products, in baked clay

This class includes:

– manufacture of non-refractory structural clay building materials:

(manufacture of ceramic bricks, roofing tiles, chimney pots, pipes, conduits, etc.)

This class also includes:

– manufacture of flooring blocks in baked clay

This class excludes:

– manufacture of structural refractory ceramic products cf. 26.26

– manufacture of ceramic flags and paving cf. 26.30

26.6 Manufacture of articles of concrete, plaster and cement

26.61 Manufacture of concrete products for construction purposes

This class includes:

– manufacture of precast concrete, cement or artificial stone articles for use in construction:

(tiles, flagstones, bricks, boards, sheets, panels, pipes, posts, etc.)

– manufacture of prefabricated structural components for building or civil engineering of cement, concrete or artificial stone

CONSTRUCTION merits a section to itself (F). Division 45 includes:

- new construction, restoration and ordinary repair

Group 45.1 Site preparation

Class 45.11 Demolition and wrecking of buildings; earth moving (approx 8000)

This class includes:

- demolition or wrecking of buildings and other structures
- clearing of building sites
- earthmoving: excavation, landfill, levelling and grading of construction sites, trench digging, rock removal, blasting, etc.
- site preparation for mining: overburden removal and other development and preparation of mineral properties and sites

This class also includes:

- building site drainage
- drainage of agricultural or forestry land

Class 45.12 Test drilling and boring

This class includes:

- test drilling, test boring and core sampling for construction, geophysical, geological or any other similar purpose

Group 45.2 Building of complete constructions or parts thereof; civil engineering

Class 45.21 General construction of buildings & civil engineering works

45.21/1 Construction of commercial buildings

This subclass includes:

- assembly and erection of prefabricated commercial buildings on the site

45.21/2 Construction of domestic buildings

This subclass also includes:

- assembly and erection of prefabricated domestic buildings on the site

45.21/3 Construction of civil engineering constructions

This subclass includes:

- construction of civil engineering constructions:
 - . bridges, including those for elevated highways, viaducts, tunnels and subways
 - . long distance pipelines, communication and power lines
- urban pipelines, urban communication and power lines; ancillary urban work
- assembly and erection of prefabricated civil engineering constructions on the site

Class 45.22 Erection of roof covering and frames

This class includes:

- erection of roofs
- roof covering
- waterproofing

Class 45.23 Construction of highways, roads, airfields and sport facilities

This class includes:

- construction of highways, streets, roads, other vehicular and pedestrian ways
- construction of railways
- construction of airfield runways
- construction work other than of buildings for stadiums, swimming pools, gymnasiums, tennis courts, golf courses and other sports installations
- painting of markings on road surfaces and parking lots

Class 45.24 Construction of water projects (approx 1500)

This class includes:

- construction of:
 - . waterways, harbour and river works, pleasure ports (marinas), locks, etc.
 - . dams and dykes
- dredging
- sub-surface work

Class 45.25 Other construction work involving special trades

This class includes:

- construction activities specialising in one aspect common to different kinds of structures, requiring specialised skills or equipment:
 - . construction of foundations, including pile driving
 - . water well drilling and construction, shaft sinking
- erection of not self-manufactured steel elements
- steel bending
- . brick laying and stone setting
- scaffolds and work platform erecting and dismantling, including renting of scaffolds and work platforms
- . erection of chimneys and industrial ovens

Group 45.3 Building installation and completion

Class 45.31 Installation of electrical wiring and fittings

This class includes:

- installation in buildings or other construction projects of:
 - . electrical wiring and fittings
 - . telecommunication systems
 - . electrical heating systems
 - . lifts and escalators
 - . fire alarms
 - . burglar alarm systems
 - . residential antennas and aerials
 - . lightning conductors, etc.

Class 45.32 Insulation work activities

This class includes:

- installation in buildings or other construction projects of thermal, sound or vibration insulation

Class 45.33 Plumbing

This class includes:

- installation in buildings or other construction projects of:
 - . plumbing and sanitary equipment
 - . gas fittings
 - . heating, ventilation, refrigeration or air conditioning equipment and ducts
 - . sprinkler systems

Class 45.34 Other building installation

This class includes:

- installation of illumination and signalling systems for roads, railways, airports and harbours
- installation in buildings or other construction projects of fittings and fixtures not elsewhere classified

Group 45.4 Building completion

Class 45.41 Plastering

This class includes:

- application in buildings or other construction projects of interior and exterior plaster or stucco including related lathing materials

Class 45.42 Joinery installation

This class includes:

- installation of not self-manufactured doors, windows, door and window frames, fitted kitchens, staircases, shop fittings and the like, of wood or other materials
- interior completion such as ceilings, wooden wall coverings, movable partitions, etc.

Class 45.43 Floor and wall covering

- laying, tiling, hanging or fitting in buildings or other construction projects of:
 - . ceramic, concrete or cut stone wall or floor tiles
 - . parquet and other wood floor coverings
 - . carpets and linoleum floor coverings including of rubber or plastic
 - . terrazzo, marble, granite or slate floor or wall coverings
 - . wallpaper

Class 45.44 Painting and glazing

This class includes:

- interior and exterior painting of buildings
- painting of civil engineering structures
- installation of glass, mirrors, etc.

Class 45.45 Other building completion

This class includes:

- installation of private swimming pools
- steam cleaning, sandblasting and similar activities for building exteriors
- other building completion and finishing work not elsewhere classified

Group 45.5 Renting of construction or demolition equipment with operator

Class 45.50 Renting of construction or demolition equipment with operator

Subsection DI, Manufacturing Of Other Non-metallic Mineral Products also includes in division 26

code 26.70 - Cutting, shaping and finishing of ornamental and building stone.

This class includes: cutting, shaping and finishing stone for use in construction, in cemeteries, on roads, as roofing, etc.

This class **excludes**:

- activities carried out by operators of quarries, e.g.,
 - production of rough cut stone cf. 14.11 (quarrying, rough trimming and sawing monumental and building stone such as marble, granite, sandstone, etc)
 - production of millstones, abrasive stones and similar products cf. 26.81

Activities included within this code:

SIC 26.70 Cutting, shaping and finishing of ornamental and building stone

4959	Alabaster bowl cutting
2450	Cutting, shaping and finishing of stone for use in construction
2450	Decorated building stone
2450	Dolomite (ground)
2450	Funerary stonework
2450	Granite working
2450	Kerbstone (not concrete)
2450	Limestone (ground)
2450	Limestone working
2450	Litho stone working
2450	Marble masonry working
2450	Millstone and grindstone cutting
2450	Monumental stonework
2450	Paving stone
2450	Slate polishing
2450	Slate slab and sheet cutting and preparation
2450	Slate working
2450	Stone working
2450	Tiles made of slate

Section C Mining and Quarrying includes Subsections CA, Mining and Quarrying of Energy-Producing Materials and CB, Mining and Quarrying Except Energy-Producing Materials

Within Division 10, Mining of Coal and Lignite; Extraction Of Peat
Division 10.10/2 Opencast coal working includes:

mining of hard coal: surface mining
cleaning, sizing, grading, pulverising, etc. of opencast coal
This subclass also includes:
recovery of hard coal from tips

Division 14, Other mining and quarrying includes

14.1 Quarrying of stone

14.11 Quarrying of stone for construction

This class includes:

- quarrying, rough trimming and sawing of monumental and building stone such as marble, granite, sandstone, etc.

This class excludes:

- cutting, shaping and finishing of stone outside quarries cf. 26.70

14.12 Quarrying of limestone, gypsum and chalk

This class includes:

- quarrying, crushing and breaking of limestone for industrial and constructional uses
- mining of gypsum and anhydrite
- mining of chalk
- mining of marl

14.13 Quarrying of slate

14.2 Quarrying of sand and clay

14.21 Operation of gravel and sand pits

This class includes:

- extraction and dredging of industrial sand, sand for construction and gravel
- breaking and crushing of shingle, gravel and sand

This class excludes:

- mining of bituminous sand cf. 11.10 [extraction of crude petroleum and gas]

14.22

Mining of clays and kaolin

This class includes:

- extraction of clays for brick, pipe and tile making
- extraction of special clays including ball clay, china clay, fire-clay, fuller's earth, etc.

14.3 Mining of chemical and fertilizer minerals

14.30 Mining of chemical and fertilizer minerals

This class includes:

- mining of natural phosphates and natural potassium salts
- mining of native sulphur
- extraction and preparation of pyrites and pyrrhotite
- mining of natural barium sulphate and carbonate (barytes and witherite), natural borates, natural magnesium sulphates (kieserite)
- mining of earth colours and fluorspar

This class also includes:

- guano mining

This class excludes:

- production of salt cf. 14.40
- roasting of iron pyrites cf. 24.13
- manufacture of synthetic fertilizers and nitrogen compounds cf. 24.15

14.4 Production of salt

14.40 Production of salt

This class includes:

- extraction of salt from underground including by dissolving and pumping
- salt production by evaporation of sea water or other saline waters
- production of brine and other saline solutions
- crushing, purification and refining of salt

This class excludes:

- potable water production by evaporation of saline water cf. 41.00

14.5 Other mining and quarrying not elsewhere classified

14.50 Other mining and quarrying not elsewhere classified

This class includes:

- mining and quarrying of various minerals and materials:
- abrasive materials, asbestos, siliceous fossil meals, natural graphite, steatite (talc), feldspar, etc.
- gem stones, quartz, mica, etc.
- natural asphalt and bitumen

APPENDIX D: REPORT OF THOR ENQUIRY

Cases of respiratory disease attributed to silica

Data request specification:

- Cases of respiratory disease attributed to silica (specifically, silicosis, lung cancer, COPD).
- Cases of respiratory disease attributed to silica in stonemasons.
- Cases of respiratory disease attributed to silica by industrial sector.

NOTE: respiratory cases reported to SWORD are reported under the following categories: asthma, inhalation accidents, allergic alveolitis, bronchitis/emphysema, infectious disease, non-malignant pleural disease, mesothelioma, lung cancer, pneumoconiosis and other. Please note that COPD does not have its own specific reporting category within the SWORD reporting system, however a search for this terminology for cases associated with silica exposure in the SWORD or OPRA databases did not identify any cases.

Sources of information:

- Cases of respiratory disease reported to SWORD by chest physicians (1989-2005) or OPRA by occupational physicians (1996-2005).

Selection of cases

- Cases of respiratory disease where the following substance codes were used:
 - 530 – Silica and natural silicates
 - 531 – Silica (crystalline)
 - 539 – Other silicates
- As above, using the following occupational codes:
 - SOC90: 500 Bricklayers, masons
 - SOC2000: 5312 Bricklayers, masons

Results

Data are presented using the diagnostic categories specified on the SWORD reporting card. There were 747 estimated cases of respiratory disease attributed to silica, (417 actual) reported to SWORD between 1989-2005 and 27 estimated cases, (5 actual) reported to OPRA between 1996-2005. Please note the total number of diagnoses may exceed the total number of cases, as each case may have more than one diagnosis. These data are summarised in Table 1a, and for stonemasons only in Table 1b.

Category A = asthma

SWORD: 4 actual diagnoses (15 estimated)

OPRA: 0

Of these 4 diagnoses;

1 was reported as asthma due to sensitisation (to silica, resin & cobalt in a chemical process worker)

and 3 were not specified regarding sensitisation/irritation:

- agent = china clay & associated material job = cleaner in china clay workshop
- agent = silicon dust & high temperatures job = glass blower
- agent = sand & cement job = concrete pourer / finisher

Category B = inhalation accidents

SWORD: 1 actual diagnosis (1 estimated)

OPRA: 0

This case was attributed to a silica product placed between 2 layers of glass to prevent them from fusing together in a furnace (60% crystalline silica)

Category D = bronchitis/emphysema

SWORD: 19 actual diagnoses (41 estimated)

OPRA: 0

Of these, 10 were solely attributed to silica and 1 to quartz dust, while 8 were reported as being exposed to silica plus other agents

Category E = infectious disease

SWORD: 2 actual diagnoses (2 estimated)

OPRA: 0

Both were reported as TB, in a quarryman and in a concrete driller

Category F = non malignant pleural disease

SWORD: 5 actual diagnoses (16 estimated)

OPRA: 0

Of these, 3 cite silica as the sole agent (2 chemical works operatives and 1 quarry worker), 1 cites quartz (in a miner), and 1 cites marble (in a terrazzo polisher)

Category H = lung cancer

SWORD: 6 actual diagnoses (28 estimated)

OPRA: 0

Of these, 2 were reported as being exposed to asbestos in addition to silica, 1 was reported as exposed to silicate or marble, while 3* were solely associated with silica exposure

(*2 of these had a co-diagnosis of silicosis)

Category I = pneumoconiosis

SWORD: 379 actual diagnoses (654 estimated)

OPRA: 5 actual diagnoses (27 estimated)

There were 3 reports with pneumoconiosis plus a second diagnosis:

as noted in category H above, 2 also diagnosed with lung cancer (reported as being exposed solely to silica) and 1 other also diagnosed with bronchitis / emphysema (being exposed to iron in addition to silica)

Category J = other

SWORD: 6 actual diagnoses (6 estimated) OPRA: 0

These included diagnoses of acute irritant bronchitis, rhinitis, and bronchiolitis,

Table 1a: All cases of respiratory disease attributed to silica (SWORD 1989-2005 & OPRA 1996-2005) by diagnostic category

Diagnostic Category	SWORD		OPRA	
	Estimated	Actual	Estimated	Actual
A. Asthma	15	4	0	0
B. Inhalation accidents	1	1	0	0
C. Allergic alveolitis	0	0	0	0
D. Bronchitis/ emphysema	41	19	0	0
E. Infectious disease	2	2	0	0
F. Non-malignant pleural disease	16	5	0	0
G. Mesothelioma	0	0	0	0
H. Lung cancer	28	6	0	0
I. Pneumoconiosis	654	379	27	5
J. Other respiratory disease	6	6	0	0
Total Diagnoses	763	422	27	5

Table 1b: Cases of respiratory disease attributed to silica (SWORD 1989-2005 & OPRA 1996-2005) by diagnostic category in stonemasons

Diagnostic Category	SWORD		OPRA	
	Estimated	Actual	Estimated	Actual
Asthma	0	0	0	0
Inhalation accidents	0	0	0	0
Allergic alveolitis	0	0	0	0
Bronchitis/ emphysema	0	0	0	0
Infectious disease	0	0	0	0
Non-malignant pleural disease	0	0	0	0
Mesothelioma	0	0	0	0
Lung cancer	2	2	0	0
Pneumoconiosis	65	32	1	1
Other resp	1	1	0	0
Total Diagnoses	68	35	1	1

The case in 'other respiratory' was assigned a diagnosis of bronchiolitis.

Information on industry was not collected before 1996. Table 2 shows cases of respiratory disease attributed to silica from 1996-2005 by industry.

Table 2: All Cases of Respiratory Disease Attributed to Silica By Industry (SWORD 1996-2005 & OPRA 1996-2005)

SIC Description	SWORD	OPRA
Manufacture of Basic Metals	92	1
Other Mining and Quarrying	89	0
Mining of Coal and Lignite; Extraction of Peat	57	0
Construction	52	2
Manufacture of Other Non-Metallic Mineral Products	33	24
Mining of Metal Ores	15	0
Manufacture of Fabricated Metal Products, Except Machinery and Equipment	13	0
Manufacture of Chemicals and Chemical Products	12	0
Manufacture of Motor Vehicles, Trailers and Semi-Trailers	3	0
Forestry, Logging and Related Service Activities	1	0
Publishing, Printing and Reproduction of Recorded Media	1	0
Manufacture of Machinery and Equipment nec	1	0
Manufacture of Other Transport Equipment	1	0
Manufacture of Furniture; Manufacturing nec	1	0
Sale, Maintenance and Repair of Motor Vehicles and Motor Cycles; Retail Sale of Automotive Fuel	1	0
Education	1	0
Health and Social Care	1	0
Recreational, Cultural and Sporting Activities	1	0
Other Service Activities	1	0
Total	376	27

Generic footnote:

- Estimated cases = (cases reported on a monthly basis) + cases reported by sample reporters during a single randomly allocated month per year x 12) therefore cells based on a small number of actual cases may exhibit appreciable random fluctuation
- Information from THOR schemes is published in HSE statistics available from their website usually towards the end of the year after the year in question. Ordinarily we advise enquirers to search or await the corresponding aggregated reports published by HSE. For reasons of ethics and confidentiality we are limited in the extent to which we can disclose disaggregated data. We have carried out a limited (but not double-checked) analysis of our database and have thus provided you with the above information. However we are not transferring any intellectual property or copyright since after further analysis we may be submitting the double-checked and validated data for peer-reviewed publication.
- THOR is to be acknowledged as the source of the data: <http://www.coeh.man.ac.uk/thor>

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 Date: 3 July 2006
 2006-12-SWORD

APPENDIX E - STONEMASONRY INDUSTRY: FOLLOW-UP QUESTIONNAIRE

Silica Baseline Survey

Company Name –

Contact name -

1 What types of stone does your company most commonly use?

e.g. Sandstone, granite, marble, limestone etc.

If a variety what percentages for each%???

2 Are you aware of the forthcoming reduction to the current Workplace Exposure Limit (WEL) for respirable crystalline silica due to come into force from October 2006?

Note: Before 2005 the WEL was known as either an OES or MEL, some respondents may not be aware that OES and MEL's have been replaced.

If YES go to question 3. If NO go to question 5.

3 Do you know what the current WEL is and what the revised level will be? (OLD – 0.3mg/m³ 8hr TWA / NEW - 0.1mg/m³ 8hr TWA)

4 Do you have any plans to introduce or improve dust control measures in your workplace in response to the introduction of the new WEL in October 2006?

5 There are various pieces of HSE guidance aimed at helping employers control the risks posed by stonemasonry dust to their workers health; are you aware of / or have made use of any of the following?:

- HS(G) 201 'Controlling Exposure to Stonemasonry Dust: Guidance for Employers'
- INDG315 'Stone Dust & You; Guidance for Stonemasons'
- Control of Substances Hazardous to Health Regulations (COSHH Regs)
- COSHH / Silica Essentials

6 Do you know what long term illnesses are associated with exposure to respirable silica dust?

Examples: Silicosis

Lung cancer

COPD (emphysema, bronchitis etc.)

7 Do you have Internet access?

If YES go to question 8. If NO go to question 9.

8 Would you be interested in receiving further information from HSE via the internet regarding control of exposure to silica and the forthcoming changes to the Workplace Exposure Limit (WEL)?

9 Would you be interested in receiving further information from HSE through the post regarding control of exposure to silica and the forthcoming changes to the Workplace Exposure Limit (WEL)?

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Silica baseline survey

Main report

The Silica Baseline Survey (SBS) has established baseline intelligence on employee exposures and the control of respirable crystalline silica (RCS) in 4 UK industry sectors: brick- and tile-manufacture, stonemasonry, quarrying and construction.

The objectives were: 1) to establish whether engineering controls and the use of respiratory protective equipment (RPE) were adequate to reduce exposures below the Workplace Exposure Limit (WEL) for RCS; 2) to assess the reliability of the exposure controls (termed 'competence'); 3) to identify common causes of failures of exposure controls, and 4) to provide data against which the effect of HSE interventions can be assessed in future.

Findings:

Assessments had not always been made as required by the Control of Substances Hazardous to Health ('COSHH') Regulations for tasks that cause RCS exposure, and there was an almost universal lack of adequate RPE training and face-fit testing. In general, the measured exposures and the effectiveness of exposure controls reflected the expertise applied to the COSHH assessments for silica. Engineering controls often failed to deliver the desired exposure reductions because of either poor design or neglected maintenance.

At brickworks, where Local Exhaust Ventilation might have been practicable, better-specified and engineered systems would have been necessary if the full benefits of such investment were to be realised.

The construction activities assessed revealed that effective exposure control was achieved where risk assessments had been performed, but uncommon in their absence.

Nearly half of the measurements of exposures at stonemasons exceeded the 2006 WEL for RCS. Engineering controls were usually either completely lacking or of limited effectiveness, the latter due either to the selection of unsuitable equipment or inadequate design and installation.

RCS exposure was generally adequately controlled in quarries. Large quarry groupings were well-equipped in terms of health and safety expertise, but exposure control regimes failed if neglected.

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